

[COMMITTEE PRINT]

COMMERCIAL SPACE LAUNCH SERVICES:
THE U.S. COMPETITIVE POSITION

REPORT

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LETTER OF TRANSMITTAL

U.S. HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY,
Washington, DC, October 22, 1991.

Members of the Committee on Science, Space, and Technology:

As you know, the development of a robust commercial expendable launch vehicle industry has become one of the highest priorities of the civil space program over the past five years. There has also emerged during this time, substantial space launch programs by other space faring nations, both market and non-market. The Committee has sought to assess the global trends in launch services and to develop a full understanding of the factors that affect the U.S. competitive position.

I am pleased to submit herewith this report entitled, "Commercial Space Launch Services: The U.S. Competitive Position" by David P. Radzanowski and Marcia S. Smith. This document discusses the current issues that relate to commercial launch services and maintaining U.S. competitiveness with foreign suppliers. Furthermore, it deals with the U.S. government's involvement and the role it should play in the commercial launch industry.

Sincerely,

GEORGE E. BROWN, Jr., *Chairman.*





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LETTER OF SUBMITTAL

October 4, 1991

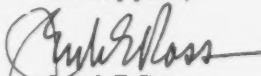
Honorable George Brown
Chairman
Committee on Science, Space and Technology
House of Representatives
Washington, D.C. 20515

Dear Mr. Chairman:

Pursuant to your committee's request, we are forwarding this report on the status of commercial launch services around the world and the policy issues facing Congress on this topic. This report addresses both commercial sounding rockets, and launch services for satellites intended to reach Earth orbit.

The report was prepared by David P. Radzanowski, Analyst in Aerospace Policy, and Marcia S. Smith, Specialist in Aerospace Policy, of our Science Policy Research Division. Information is current through September 1, 1991. We hope it is useful to you and your committee in your deliberations on the U.S. space program and its competitive position in the world.

Sincerely yours,


Joseph E. Ross
Director

(V)





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COMMERCIAL SPACE LAUNCH SERVICES: THE U.S. COMPETITIVE POSITION

Prepared at the Request
of the
House Committee on Science, Space and Technology

by
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(VII)



EXECUTIVE SUMMARY

Until the late 1970s, any country or company in the western world wanting to orbit a satellite on a commercial basis had one choice--the U.S. National Aeronautics and Space Administration (NASA). The situation has changed dramatically since then as foreign competitors emerged and a commercial launch services industry developed in the United States. Most commercial launches are for communications satellites, and today customers may choose one of three U.S. companies, a European company, or the government of China for launch services. The Soviet Union is attempting to enter the market, and Japan may begin offering launch services in the 1990s. At the same time, an entirely new market is developing for suborbital launches as well.

A host of issues have developed in relation to commercial launch services centering on how to maintain U.S. competitiveness with foreign suppliers. Congress and the Reagan and Bush Administrations have sought ways to facilitate the U.S. commercial launch services industry through legislation such as the 1984 Commercial Space Launch Act and the 1988 Commercial Space Launch Act Amendments, and through presidential policies. Both Congress and the Administration continue to show strong interest in assisting this nascent industry. Ultimately, the success of the U.S. companies, and how many of them can survive, will depend to a great extent on the size of the commercial market. Many observers contend that there are too many suppliers for the demand and no matter what the U.S. Government does to support commercialization, three major U.S. suppliers cannot survive.

Concurrently, tension has developed between the commercial launch services companies and U.S. companies that build satellites. To the extent that the U.S. Government seeks to assist the launch services companies by prohibiting the export of U.S.-built satellites to certain countries for launch, satellite manufacturers fear customers will seek non-U.S. companies to build the satellites to avoid the political quagmire of U.S. export policy. Since virtually every satellite in the free world is either manufactured in the United States or by European companies with U.S. subcontractors (and Europe similarly wants to limit foreign launch service competition), it is not clear how realistic that fear is today. However, as other countries, such as Canada and Japan, continue to build their satellite manufacturing capabilities, this could become more important.

THE MARKET FOR LAUNCH SERVICES

The demand for commercial launch services comes from two main sectors: private companies and governments. Estimates of the size of the market by U.S. and foreign launch service providers indicate that U.S. commercial and foreign demand for large capacity launch services between 1991 and 2000 will range from 15 to 25 satellites per year. The U.S. commercial and foreign demand for small to medium capacity expendable launch vehicle (ELV) services is expected to be eight to 12 flights per year over the next 10 years. Finally, the demand for suborbital flights is expected to total 80 to 110 flights over the next decade, or between 8 and 11 flights per year.

Estimating the size of the market is extremely difficult. For communications satellites, for example, new technologies such as fiber optic cables may shrink the demand for satellite links. Alternatively, new satellite technologies such as direct broadcast television and mobile communications may increase it. The demand for commercial satellite launches is inherently unpredictable, yet it is critical in assessing the future of commercial launch services. The estimates do not include the vast majority of satellites that will be launched, since most countries with their own launch capabilities tend to launch their own spacecraft (U.S. Government satellites must be launched on U.S. launch vehicles; Soviet and Chinese satellites are launched by those countries; and so forth.) If those markets were opened to commercial launch service providers, the prospects for the industry could be quite different.

THE U.S. SPACE SHUTTLE AND EUROPE'S ARIANE

Commercial launch services did not begin until the early 1970s when private companies and foreign governments began purchasing their own communications satellites (which still dominate the market for launch services today). Through NASA, launches for those satellites could be procured on any of four ELVs, in order from largest to smallest: Titan, built by Martin Marietta; Atlas, built by General Dynamics; Delta, built by McDonnell Douglas; and Scout, made by LTV Aerospace Corporation.

All the ELVs, except Scout, were to be phased out of use in the 1980s in favor of the U.S. space shuttle, which was intended to take all U.S. Government satellites, as well as commercial satellites, into orbit. The shuttle made its first flight in 1981 and was declared operational in 1982. Meanwhile, however, the European Space Agency (ESA) had decided to develop its own ELV, Ariane, which became the first competitor to NASA for commercial launches. The first Ariane launch was conducted in 1979, and in 1984, a private company, Arianespace, took over commercial operation of the vehicle.

The decision to phase out the U.S. ELVs was controversial, and some launch vehicle manufacturers expressed interest in offering the vehicles commercially themselves. In 1983, President Reagan released a commercial ELV policy encouraging the private sector to do exactly that and later designated the Department of Transportation (DOT) to facilitate ELV commercialization. Congress passed the Commercial Space Launch Act of 1984 (P.L. 98-575) to

further define the goals set forth by the Administration and delineate DOT's responsibilities.

The companies argued, however, that the U.S. Government was subsidizing the space shuttle to such an extent that they could not compete with NASA. Questions also arose regarding whether European governments were subsidizing Ariane. In 1984, Transpace Carriers, Inc., which was attempting to market commercial launches on Delta, filed a complaint with the Office of the U.S. Trade Representative (USTR) alleging that Europe was subsidizing Ariane. USTR concluded that ESA's practices in pricing Ariane launches were not substantially different from NASA's in charging for launches on the space shuttle and dismissed the case.

By 1985, both China and the Soviet Union had tentatively expressed interest in offering commercial launches, too, but there was little activity by either country. Commercial customers essentially had to choose between the U.S. shuttle and Europe's Ariane for placing satellites in orbit.

THE CHALLENGER ACCIDENT AND THE EMERGENCE OF THE U.S. COMMERCIAL LAUNCH INDUSTRY

In 1986, the situation changed dramatically. In the wake of the January 28, 1986 space shuttle *Challenger* tragedy, the U.S. Government reversed its policy of phasing out ELVs. Instead, it adopted a "mixed fleet" approach where both ELVs and the shuttle would be available for "assured access to space" for commercial and Government users. In August 1986, President Reagan issued a directive limiting NASA's role in providing commercial launches to those satellites that required the unique capabilities of the shuttle or for which there were unusual foreign policy considerations.

Coupled with the already enacted legislation and policies, the stage was set for the emergence of a U.S. commercial launch services industry. The three major launch vehicle manufacturing companies, along with entrepreneurial firms interested in both orbital and suborbital launches, developed plans for marketing their respective vehicles. Congress and the Administration remained strongly interested in steps that could be taken to facilitate the success of these efforts. A February 1988 Reagan Administration policy required U.S. Government agencies to purchase commercial launch services to the fullest extent feasible so that, for example, NASA would purchase launch services for its own satellites, rather than purchasing launch vehicles and conducting the launch itself. The Air Force, deciding that it needed new medium capacity ELVs, selected McDonnell Douglas to build a new version of the Delta (Delta II), and General Dynamics to build a new version of the Atlas (Atlas II), with the specific intent that these vehicles also be made available commercially. (The Air Force already had decided, in 1984, to procure an improved version of the Titan --Titan IV.) Hence, each of the three major manufacturing companies were able to embark upon improved launch vehicle production lines with an assured Government market.

Stiff competition from Ariane, which by now had cornered at least half the market, and strong marketing by China and the Soviet Union, kept Congress and the Administration interested in this issue. To further assist the commercial launch industry, in 1988 Congress passed the Commercial Space Launch Act Amendments which provided continued access to Government launch facilities by the commercial launch companies and indemnified launches for third party liability for claims between \$500 million and \$2 billion. In 1989, the Bush Administration released its National Space Policy which reaffirmed all the provisions in the Reagan Administration's space policy pertaining to the commercial space launch industry.

The entrance of China and the Soviet Union into the market created concerns about technology transfer, but even more significantly about the potential for unfair competition. With their non-market economies, U.S. companies claimed, these countries could undercut any price offered by a Western launch services provider. In January 1989, the United States and China signed a bilateral agreement detailing conditions under which China would join the launch services business. Among the provisions was a requirement that China charge prices "on a par" with other launch services providers. China launched the U.S.-built Asiasat communications satellite in 1990 and has contracts to launch two more U.S.-built communications satellites (owned by Australia) as well as a Swedish scientific satellite, all in 1992.

Chinese launches have been particularly contentious because of U.S. dissatisfaction with internal Chinese human rights and political freedom policies following the 1989 Tiananmen Square uprising, and concerns about China's ballistic missile proliferation policies. Satellite export issues have become intricately connected with overall U.S./China policy. Added to the concern that China has abrogated its bilateral agreement with the U.S. on launch services by charging prices below par, it appears that satellite exports to China will continue to be controversial for the indefinite future. Congress passed legislation in 1989 and 1990 (P.L. 101-162 and P.L. 101-246) prohibiting the export of satellites to China unless it improved its internal political situation or unless the President certified that exporting satellites was in the U.S. national interest. Pending legislation (S. 320, the Omnibus Export Amendments Act of 1991) would require the President to certify that China is abiding by the terms of its agreement with the U.S. before any more satellites are exported to China.

U.S. policy towards the Soviet Union remains much stricter than for China--no satellites containing U.S. components can be launched from the Soviet Union. This policy is being restudied as part of the overall review of U.S. export control policy toward Eastern Europe and the Soviet Union. Since the policy purportedly is based on technology transfer concerns, an Australian company (the Cape York Space Agency--CYSA, not part of the Australian government) proposed buying Soviet launch vehicles and launching them from Cape York, Australia. Thus, the satellites would be exported to Australia, not the Soviet Union, and CYSA asserted that no Soviets would be at the launch site. Instead, it proposed using a U.S. company (U.S. Space Boosters, Inc.--USB) to manage the site. In September 1990, the Bush Administration released a Commercial

Space Launch Policy which set conditions for USBI to participate in the Cape York proposal, one of which the Soviets have rejected. Financial problems for CYSA have also placed the future of this project in doubt.

President Bush's 1990 policy also formally stated that U.S. Government payloads must be launched on U.S. launch vehicles. The Government is the single largest consumer of domestic space launch services and one of the most important ways the U.S. Government influences the competitiveness of the U.S. space launch industry is through its policies and practices for purchasing space launch services. President Bush's policy also stated that the U.S. Government would enter into negotiations with the European Space Agency (ESA) and others to define principles of free and fair trade ("rules of the road") and how to deal with the entry of non-market economy launch providers such as China and the Soviet Union. Negotiations with ESA are underway, and ESA has raised the issue of opening the U.S. civilian Government market to Ariane launches. An amendment was added to the FY1992 NASA authorization bill (H.R. 1988) reaffirming existing U.S. policy of permitting foreign launches of U.S. Government satellites only if the President explicitly grants a waiver, and further stating that such a waiver should be granted only if U.S. companies would not be harmed by the waiver.

THE U.S. COMMERCIAL SPACE LAUNCH INDUSTRY TODAY

The first U.S. licensed commercial launch took place on March 29, 1989. Space Services, Inc., launched its Starfire suborbital rocket that carried a microgravity sciences research payload. On August 27, 1989, the first U.S. commercially licensed orbital launch took place when a McDonnell Douglas Delta launched Britain's Marcopolo 1 broadcasting satellite. As of June 1991, the Office of Commercial Space Transportation had issued 22 licenses for commercial launches since 1988. By June 24, 1991, 20 commercially licensed launches had taken place (15 of which were orbital); five were failures (two of these were orbital launches). The U.S. Commercial Launch Manifest issued in the first quarter of 1991 contains listings for 30 commercial launches from June 1991 to 1995 (18 of these are for orbital launches).

In the U.S., large capacity ELV services are currently offered by McDonnell Douglas with its Delta II vehicle, General Dynamics with its Atlas I and II vehicles, and Martin Marietta with its Commercial Titan launch vehicle. Small capacity ELV services (orbital and suborbital) are offered by Orbital Sciences Corporation with its Pegasus air-launched vehicle, Space Data (a division of Orbital Sciences) with its Aries, Talos Castor-1, and Prospector suborbital rockets, LTV Corporation with its Scout I and II vehicles, and Space Services (a division of EER Systems) with its Conestoga launch vehicle. Other small firms are also offering small capacity launch services, including: American Rocket Company (AMROC), E Prime Aerospace, and Conatec.

U.S. commercial launch firms currently rely upon the existing national launch facilities to support their operations. U.S. firms offering launch services are able to offer only the launch vehicle itself and the technical support required to prepare the vehicle for operation; they do not own their own launch sites.

In accordance with National Space Policy, the U.S. Government provides for the use of ELV launch sites, property and services on a direct cost reimbursable basis. The U.S. Government operates four launch ranges that are used or may be used for commercial launches: Vandenberg Air Force Base in California and Cape Canaveral Air Force Station in Florida; the Army's White Sands Missile range in New Mexico; and NASA's Wallops Flight Facility in Virginia. Cape Canaveral and Vandenberg can support launches of a wide variety of orbital and suborbital rockets. Wallops Island can be used for Scout launches and suborbital launches. White Sands supports only suborbital launches. (Pegasus is launched from an aircraft. On its two flights to date, the aircraft departed from Edwards Air Force Base, CA, but Edwards is not counted as a space launch site.)

Recently, several States have shown interest in constructing commercial "spaceports"--launch sites developed with private funding or through a public-private funding partnership, operated by a private firm, and used only for commercial launches. Commercial spaceports have been proposed by the States of Florida, Hawaii, Virginia, and Alaska, with Mississippi and California also showing interest. State governments are interested in developing spaceports because they view publicly assisted spaceport development as a way of attracting high technology space industry and jobs. These States see potential future growth in space commerce, and if they are able to develop launch infrastructure in the near-term, they believe they would have a competitive advantage over other States in attracting future commerce business.

The development of commercial spaceports is also seen as an alternative for improving launch infrastructure conditions for the commercial launch industry. A September 1990 report by the Aerospace Industries Association (AIA) identified a number of problems affecting commercial space launch service companies at Cape Canaveral, including the observation that the facilities are antiquated.

CURRENT ISSUES

The ultimate success of U.S. commercial launch services will depend on many factors: the size of the world market, how effectively they are able to market their services (financing terms, insurance cost and availability, launch date availability, penalties imposed if the satellite is not ready on time, launch site location), and the number of international competitors.

U.S. policy can influence all of these factors. By keeping the U.S. Government satellite market closed to foreign launchers, a market can be assured for U.S. launch service companies. In return, however, foreign government markets may remain closed to those same U.S. companies. U.S. Government indemnification of commercial launches for certain amounts of coverage, support for research and development, and access to U.S. Government launch sites and upgrading of those sites, for example, can all be helpful in making U.S. launch services attractive to customers. However, these actions raise the issue of subsidization. The number of competitors can be affected to a great degree by U.S. policy in terms of not permitting U.S.-built satellites or

satellites with U.S. components to be exported to certain countries, but in the long-term could adversely affect satellite manufacturing companies.

Myriad issues face Congress in dealing with commercial launch services, including:

- Whether the Department of Transportation is carrying out its responsibilities effectively, especially with regard to whether commercial launch user fees should be charged and disputes with NASA over what is a "commercial" versus a "government" launch and therefore whether DOT has jurisdiction;
- The need to renovate aging U.S. Government launch facilities for the benefit of the commercial launch industry, especially the role of the Federal versus State governments;
- Whether the Federal Government should pay for research to develop new technologies specifically for the commercial launch sector;
- Whether using surplus U.S. Government missiles as launch vehicles is an effective use of excess government assets or would undermine the small launch vehicle companies who are attempting to sell launch vehicles they have developed with their own money;
- How to balance the needs of the commercial launch services companies with those of satellite manufacturers in developing policy on use of foreign launch vehicles for U.S.-built satellites;
- Whether NASA should procure commercial launches for its sounding rockets instead of conducting the launches itself;
- Whether to extend U.S. Government indemnification of commercial launches beyond 1993;
- "Rules of road" on pricing launch services developed through the ongoing negotiations between the United States and the European Space Agency;
- Whether, and under what circumstances, U.S. Government satellites could be launched on foreign launch vehicles;
- Whether to continue to allow exports of U.S.-made satellites to China for launch or to deny such exports because of concerns about internal Chinese politics regarding human rights and political freedom, Chinese ballistic missile proliferation policies, and whether China is abiding by the terms of the agreement it signed with the U.S. to charge prices "on a par" with other launch services providers;

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- Whether to loosen U.S. restrictions on the launch of U.S.-built satellites on Soviet-built launch vehicles; and
- Potential competition from Japan.

Three bills pending before the 102d Congress--the FY1992 NASA Authorization bill (H.R. 1988), the Omnibus Export Act Amendments (S. 320), and the Omnibus Space Commercialization Act of 1991 (H.R. 3153)--already deal with some of these issues.

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CHAPTER 1

U.S. COMMERCIAL LAUNCH SERVICES POLICY

Until the late 1970s, any country or company in the western world wanting to orbit a satellite on a commercial basis had one choice--the U.S. National Aeronautics and Space Administration (NASA). Commercial launch services did not begin until the early 1970s when private companies and foreign governments began purchasing their own communications satellites (which still dominate the market for launch services today). Through NASA, launches for those satellites could be procured on one of the four U.S. expendable launch vehicles (ELVs), in order from largest to smallest: Titan, built by Martin Marietta; Atlas, built by General Dynamics; Delta, built by McDonnell Douglas; and Scout, made by LTV Aerospace Corporation. NASA procured the launch vehicles from the companies and conducted the launches on a reimbursable basis for commercial customers.

During the 1970s, the U.S. developed the first reusable space launch vehicle, the space shuttle, and decided that it would become the Nation's primary space launch vehicle for both Government and commercial satellites. All the ELVs (except Scout) would be phased out. NASA argued that with its expected high launch rate, the shuttle would be substantially less expensive than ELVS for placing satellites in orbit. The first space shuttle launch occurred in 1981, and a year later it was declared operational.

Meanwhile, however, the European Space Agency (ESA) had decided to develop its own ELV, Ariane, which became the first competitor to NASA for commercial launches. The first Ariane launch was conducted in 1979, and in 1984, a private company, Arianespace, took over commercial operation of the vehicle.

REAGAN ADMINISTRATION'S POLICY 1983

The plan to phase out the ELVs was controversial. The Department of Defense (DOD) expressed concern about total reliance on a single route to space, and at the same time interest emerged in the private sector for offering ELV services on a commercial basis. The latter concept sparked interest in the Reagan Administration, and on May 16, 1983, President Reagan issued National Security Decision Directive-94 (NSDD-94) encouraging private sector development of commercial launch operations and stating that the U.S.

Government "fully endorses and will facilitate the commercialization of U.S. expendable launch vehicles (ELVs)."¹ On November 16, 1983, the President designated the Department of Transportation (DOT) as the lead agency for facilitating the commercialization of ELVs.²

A chief concern for private companies at this time was NASA's pricing policy for launches on the space shuttle. They argued that the Government was subsidizing shuttle launches, and a private company could never successfully compete with NASA.

COMMERCIAL SPACE LAUNCH ACT OF 1984

Congress also endorsed the emergence of a commercial launch services industry, and passed the Commercial Space Launch Act of 1984 on October 30, 1984.³ The Act created the Office of Commercial Space Transportation (OCST) in DOT, and required DOT to facilitate and promote commercial space launches by the private sector. OCST's duties are to:

- (1) license and regulate launches of space vehicles and the operation of launch sites by persons within the jurisdiction of the U.S., consistent with public safety, national security, and international obligations;
- (2) take actions necessary with other Federal agencies to make U.S. Government launch property and facilities available for commercial use or acquisition; and
- (3) determine the appropriate levels of liability insurance required by licensees under the Act.

Congress also debated at length NASA's pricing policy for shuttle launches, attempting to strike a balance between the private sector, arguing for high prices which realistically reflected the costs associated with a shuttle launch, and NASA, insisting on moderate prices that would allow it to compete with Ariane.

While the Government remained committed to using the shuttle as the Nation's primary launch vehicle, in 1984 the Air Force won approval to develop a version of the Titan rocket (Titan IV) as a "complementary launch vehicle," capable of launching satellites the same size and mass of those that could be launched on the shuttle. DOD had been concerned for years about "placing all its eggs in one basket" by having only the shuttle available for launching its

¹ Presidential Directive on Commercialization of Expendable Launch Vehicles, May 16, 1983.

² Executive Order 12465.

³ Commercial Space Launch Act of 1984, P.L. 98-575, Oct. 30, 1984, 49 U.S.C. 2601.

satellites. DOD officials argued that if a shuttle accident occurred, it could interrupt launches for a lengthy period since concerns about human safety would require painstaking investigations and remedies. Congress acknowledged DOD's concerns and permitted the Air Force to procure exactly 10 Titan IVs (then called the Complementary Expendable Launch Vehicle--CELV).

Despite the Reagan Administration's directives and passage of the Commercial Space Launch Act, a U.S. commercial space launch industry did not emerge. U.S. firms felt that the U.S. and European governments were subsidizing the space shuttle and Ariane, respectively, to such an extent that they could not compete. An unfair trade practices complaint was filed with the Office of the U.S. Trade Representative (USTR) by Transpace Carriers, Inc., which was attempting to market the Delta rocket, arguing that Europe was unfairly subsidizing the Ariane, but USTR dismissed the complaint because it found Europe's practices were not substantially different from NASA's (see Chapter 6 for more information).

Lacking either a Government or a commercial market, the Atlas and Delta production lines were being closed down at the end of 1985, while Martin Marietta continued to develop and produce a limited number of Titans for DOD. Commercial customers could choose only between the U.S. shuttle and Europe's Ariane.⁴

THE CHALLENGER TRAGEDY--EMERGENCE OF THE U.S. COMMERCIAL SPACE LAUNCH INDUSTRY

On January 28, 1986, the situation changed dramatically. The explosion of the space shuttle *Challenger* that day not only claimed the lives of seven astronauts, but shut down the major U.S. launch system. Within the next four months, a Titan, Delta and an Ariane also exploded during launch. All of these failures--but particularly *Challenger*--prompted a Government review of launch vehicle policy. In August, a new policy was announced shifting to a "mixed fleet" approach of using both ELVs and the shuttle in order to assure access to space for commercial and Government users, reversing the previous policy of phasing out the ELVs, and sharply limiting NASA's role in providing commercial launches in order to stimulate the domestic launch services industry.⁵ The space shuttle now could be used for commercial launches only if the payload was "shuttle-unique," requiring the special capabilities of the shuttle, or if there were foreign policy or national security considerations. The commercial launch industry was recognized as an essential component as a means to assure U.S. access to space.

⁴ China and the Soviet Union had tentatively expressed interest in offering commercial launches, too, but there was little activity by either country at this time.

⁵ National Security Decision Directive 254, Aug. 1986.

Coupled with the already enacted legislation and policies, the stage was set for the emergence of a U.S. commercial launch services industry. The three major launch vehicle manufacturing companies, along with entrepreneurial firms interested in both orbital and suborbital launches, developed plans for marketing their respective vehicles. The Air Force decided that in addition to the large capacity Titan launch vehicles, it needed new medium capacity ELVs. McDonnell Douglas was selected to build a new version of the Delta (Delta II), and General Dynamics to build a new version of the Atlas (Atlas II), with the specific intent that these vehicles also be made available commercially. Hence, each of the three major manufacturing companies was able to embark upon improved launch vehicle production lines with an assured Government market.

COMMERCIAL SPACE LAUNCH ACT AMENDMENTS OF 1988

Stiff competition from Europe's Ariane, which by now had cornered at least half the commercial market, and increased interest by China and the Soviet Union, kept Congress and the Reagan Administration strongly interested in steps that could be taken to facilitate the success of the new U.S. launch services industry.

In 1988, Congress passed the Commercial Space Launch Amendments Act,⁶ which, among other things, affirmed Government policy to provide commercial launch companies continued access to Government launch facilities (on a reimbursable basis), and set insurance requirements. In summary, the Act set the following policies:

(1) The launch provider must obtain insurance or demonstrate financial responsibility sufficient enough to compensate for the "maximum probable loss that might occur to Government property or result from third party claims." To protect Government ranges and other property, launch providers are required to obtain up to \$100 million in insurance. To protect against damage to third parties, launch providers must obtain up to \$500 million in insurance protection.

(2) The Secretary of Transportation will determine the maximum probable loss to property or third parties based on the launch vehicle size and type, launch trajectory and payload, and annually review the \$100 million and \$500 million levels.

(3) All parties to the launch must enter into reciprocal waivers of claims under which each party is responsible for any property damage or personal injuries it sustains.

(4) The Government will indemnify claims to the degree third party claims exceed the insurance up to a total of \$1.5 billion above the firm's insurance per launch incident (in other words, from \$500 million to \$2 billion). This provision expires after five years.

⁶ The Commercial Space Launch Act Amendments of 1988, P.L. 100-657, Nov. 15, 1988.

(5) The commercial launch industry will not be preempted arbitrarily from the use of Government launch ranges, but only in cases of "imperative national need" as determined by the Secretary of Defense or NASA Administrator. And,

(6) Duplicative charges cannot be imposed on commercial users whose launch schedule has been interrupted as a result of Government preemption.

REAGAN ADMINISTRATION'S NATIONAL SPACE POLICY, 1988

The Reagan Administration also demonstrated its continued interest in commercial launch services. On February 11, 1988, President Reagan released a new National Space Policy covering the broad scope of U.S. space policy.⁷ Among its many provisions, the policy required Government agencies to purchase commercial launch services (rather than procuring launch vehicles and conducting the launch operations themselves) to the fullest extent feasible. The Government is the single largest consumer of domestic space launch services and one of the most important ways the U.S. Government influences the competitiveness of the U.S. space launch industry is through its policies and practices for purchasing space launch services. The policy --

- Required NASA and DOD, in consultation with the Department of Transportation, to make national launch property, facilities, and services available for commercial use, reimbursable at direct cost;
- Reinforced the existing policy prohibitions concerning commercial use of the Shuttle;
- Prohibited NASA from maintaining an ELV adjunct to the Shuttle;
- Required the U.S. Government to purchase commercial space transportation services to meet its requirements to the fullest extent feasible;
- Prohibited the U.S. Government from competing with or deterring U.S. commercial space transportation service providers except for national security or public safety reasons;
- Required the U.S. Government to encourage international free trade in commercial space activities, and, when entering into space-related technology development and transfer agreements with other countries, to take into consideration whether such countries practice and encourage free and fair trade in commercial space activities; and
- Required that any research and development undertaken by the Government be aimed at reducing the cost of space transportation and related services. Also, the Government was encouraged to enter cooperative arrangements with industry to stimulate private sector

⁷ White House Fact Sheet, The President's Space Policy and Commercial Space Initiative, Feb. 11, 1988.

research and development, and provided for timely transfer of Government-developed space technology to the private sector in a manner which protects the commercial value of the technology.

BUSH ADMINISTRATION'S SPACE POLICY

When the Bush Administration took office in 1989, it continued to show interest in the U.S. commercial space launch industry. Under the guidance of the White House National Space Council, established by President Bush in April 1989 in accordance with language in NASA's FY1988 authorization Act, the Bush Administration has released a new National Space Policy, a Commercial Space Launch Policy, a U.S. Commercial Space Policy, and a National Space Launch Strategy. Each addresses the U.S. commercial space launch industry in some form.

National Space Policy 1989

On November 2, 1989, President Bush approved a national space policy that updated and reaffirmed U.S. goals and activities in space.⁸ The updated policy reaffirmed DOT's role as the lead agency for commercial space launch activities as well as all of the provisions in the Reagan Administration's space policy pertaining to the commercial space launch industry.

U.S. Commercial Space Launch Policy

On September 5, 1990, the Bush Administration released a new commercial space launch policy that supplements the national space policy.⁹ (See appendix 1.) The policy, spurred in part by increased efforts by China and the Soviet Union to enter the commercial launch services market, declared that U.S. Government payloads must be launched on U.S. launch vehicles unless specifically exempted by the President. The policy also stated that the U.S. Government would enter into negotiations with the European Space Agency (ESA) and others to define principles of free and fair trade ("rules of the road") and how to deal with the entry of non-market economy launch providers such as China and the Soviet Union (see Chapter 6 for more information). Among its other provisions, the policy

- stipulates that the U.S. Government consider commercial space launch needs and factor them into Government decisions on improvements in launch infrastructure and launch vehicles;
- reaffirms the U.S. Government's policy to deny, except in extraordinary circumstances, exports of satellites and satellite components to the Soviet Union;

⁸ White House Fact Sheet, U.S. National Space Policy, Nov. 16, 1989.

⁹ White House Fact Sheet, Commercial Space Launch Policy, Sept. 5, 1990.

- limits the use of Soviet launch vehicles for commercial launches to a single mutually agreed upon location outside the Soviet Union and the Soviets would be required to forgo commercial launches of Western satellites from inside the Soviet Union; and
- insists that there be an effective means of enforcing international agreements related to space launch goods and services.

U.S. Commercial Space Policy Guidelines

On February 12, 1991, the Bush Administration released a broader commercial space policy than that announced in 1990.¹⁰ Included in the policy are several guidelines that affect the U.S. commercial launch industry. These guidelines state that

- U.S. Government agencies shall utilize commercially available space products and services to the fullest extent feasible;
- U.S. Government agencies shall promote the transfer of U.S. Government-developed technology to the private sector;
- U.S. Government agencies may make unused capacity of space assets, services and infrastructure available for commercial space sector use;
- U.S. Government agencies may make available to the private sector those assets which have been determined to be excess to the requirement of the U.S. Government in accordance with U.S. law and applicable international treaty obligations. Due regard shall be given to the economic impact such transfer may have on the commercial space sector, promoting competition, and the long-term public interest;
- U.S. Government agencies shall enter into appropriate cooperative agreements to encourage and advance private sector basic research, development, and operations; and
- the U.S. will work toward establishment of an international trading environment that encourages market-oriented competition by working with its trading partners.

National Space Launch Strategy

The potential use of ballistic missiles as launch vehicles¹¹, the Administration's proposal for the development of a new family of launch vehicles called the National Launch System (NLS), and concern about the

¹⁰ White House Fact Sheet. U.S. Commercial Space Policy Guidelines, Feb. 12, 1991.

¹¹ Provisions in the signed, but not ratified, Strategic Arms Reduction Treaty (START) allow for the use of retired ballistic missiles as launch vehicles.

development of space launch technology and space launch infrastructure prompted the Administration to release a new National Space Launch Strategy to act as guidance for implementing National Space Policy with respect to access to and from space. The Administration released the new National Launch Strategy on July 24, 1991. The strategy is composed of four main elements:

- (1) Ensuring that existing space launch capabilities, including support facilities, are sufficient to meet U.S. Government space launch needs;

- (2) developing a new "unmanned," but "man-rateable," space launch system to greatly improve national launch capability with reductions in operating costs and improvements in launch system reliability, responsiveness, and mission performance;

- (3) sustaining a vigorous space launch technology program to provide cost effective improvements to current launch systems, and to support development of advanced launch capabilities, complementary to the new launch system; and

- (4) actively considering commercial space launch needs and factoring them into decisions on existing space launch capabilities, development of a new space launch system, and implementation of space launch technology programs.

Within each of these elements are provisions that take into consideration the U.S. commercial launch industry. Consistent with U.S. national security and national space policy, the U.S. Government may seek to recover residual value from ballistic missiles which are, or subsequently become, surplus to the needs of the DOD. Prior to any release of such missiles, including components, beyond those already approved for use as space launch vehicles (such as Titan IIs), the DOD will conduct, and the National Space Council and the National Security Council, will review an assessment of alternative disposition options for such missiles. Disposition options will be evaluated in terms of their consistency with U.S. national security and foreign policy interests, available agency resources, defense industrial base considerations, and with due regard to economic impact on the commercial space sector.

The DOD and NASA, who will be jointly funding, managing and developing the new launch system are to actively explore the potential for U.S. private sector participation, since the new system may provide the opportunity for significant long-term benefits to the commercial space launch industry.

The launch strategy states that the U.S. Government agencies will actively consider commercial space launch needs in the following ways:

- (1) U.S. Government agencies, in acquiring space launch related capabilities, should: allow contractors, to the fullest extent feasible, the flexibility to accommodate commercial needs when developing launch vehicles and infrastructure to meet Government needs; emphasize procurement strategies which are based on best value rather than lowest cost, performance-based functional requirements, commercial production and quality-assurance standards and techniques, and the use of commercially-offered space products

and services; encourage commercial, State, and local government investment and participation in the development and improvement of U.S. launch systems and facilities; and, provide for private sector retention of technical data rights, except those rights necessary to meet Government needs or to comply with statutory responsibilities.

(2) U.S. Government agencies should seek to remove, where appropriate, legal or administrative impediments to private sector arrangements such as industry teams, consortia, cost-sharing, and joint production agreements which may benefit U.S. Government needs and economic competitiveness. Agencies should also seek legislative authority for stable long-term commitments to purchase space transportation services.

(3) Within applicable law, U.S. Government agencies are encouraged to use industry advisory groups to facilitate the identification of commercial space launch needs and the elimination of barriers that unnecessarily impede commercial space launch activities. U.S. agencies are also encouraged to consult with State and local governments.

RECENT CONGRESSIONAL ACTION

Since the Commercial Space Launch Act Amendments of 1988, Members have introduced legislation to further the competitiveness of the U.S. commercial launch industry. The actions of the 101st Congress and the current actions of the 102d Congress are summarized below.

101st Congress

In the 101st Congress, Rep. Packard introduced H.R. 2674, the Space Transportation Services Purchase Act. The Packard bill would have required NASA and U.S. Air Force to buy commercial launch services, except under special circumstances. The Administration was against the bill because it put too many constraints on the Government, particularly the Air Force.¹² The Air Force is also reluctant to put multi-million dollar national security spacecraft in the hands of the private sector. Some language of this bill was incorporated into the NASA Authorization Act of 1991 (discussed below). Also in the 101st Congress, Rep. Walker introduced H.R. 5145, the Omnibus Space Commercialization Act of 1990, to encourage the growth of the U.S. commercial space industry. The bill would have required the Government to purchase commercial launch services, as did the Packard bill, and it would have sold surplus Government launch facilities, designate partially tax exempt commercial launch zones, and create tax incentives for investment in them. This bill did not

¹² Lawler, Andrew. Private Launch Bill Gets Lukewarm Reception. *Space News*, Feb. 26-Mar. 4, 1990. p. 19; and Suggested Launch Act Changes Opposed by Space Council, Pentagon. *Aerospace Daily*, May 11, 1990. p. 244.

make it out of committee during the 101st Congress. The bill was redrafted and reintroduced in the 102d Congress (discussed below).¹³

The NASA Authorization Act of 1991 (P.L. 101-611) codified the policy specifying the use of the shuttle only for missions that require the presence of humans, the unique capabilities of the shuttle, or under other compelling circumstances. If such requirements are not met, the payload would have to be launched on an ELV. In addition, incorporating language from the Packard bill (H.R. 2674), the Act directed NASA to purchase launch services for its primary payloads from commercial launch companies whenever such services are required except when the services are not available, the services would pose an unacceptable risk to the payload, or the payload has national security purposes. This could further expand the market for launch services by moving satellites off the shuttle and onto ELVs.

Congress began to address the concept of commercial spaceports in the FY1991 NASA Authorization Act (P.L. 101-611) by amending four sections of the 1984 Commercial Space Launch Act (P.L. 98-575). These amendments to the 1984 Commercial Space Launch Act are designed to advance the spaceport concept and to assist State governments in establishing launch sites for commercial space activities. The amendments also lay a foundation for creating a joint effort among the Federal Government, State governments, and the private sector to facilitate space commerce.¹⁴

Congress was also concerned about the launch of satellites on Chinese rockets. Showing dissatisfaction with internal Chinese policies and concern that the Chinese abrogated its bilateral agreement with the U.S. on commercial launches, Congress passed legislation (P.L. 101-162 and P.L. 101-246) prohibiting the export of satellites to China unless it improved its internal political situation or unless the President certified that exporting the satellites was in the U.S. national interest (See Chapter 6 for further information).

102d Congress

The 102d Congress has continued congressional interest in the commercial launch industry. The NASA Authorization Act of 1992 (H.R. 1988) passed by the House on May 2, 1991, authorizes \$10 million in FY1992 to initiate a commercial launch technology development program in NASA. The component technology program is to develop propulsion, guidance and control, vehicle, ground support, and other technologies that could benefit the U.S. commercial launch industry. On May 14, 1991, the Senate Commerce Committee also authorized \$10 million in FY1992 for the program. Also within this bill is language reaffirming existing U.S. policy of permitting foreign launches of U.S. Government payloads only if the President explicitly grants a waiver, and

¹³ Hopkins, Mark. Supporting Commercial Space. *Ad Astra*, June 1991. p. 13.

¹⁴ Blumel, Robert. Government Support For Spaceports? *Satellite Communications*, Jan. 1991. p. 16.

further stating that such a waiver should be granted only if U.S. companies would not be harmed by the waiver.

H.R. 1988 also contains House language for updating space launch infrastructure. The House recommended that up to \$20 million be authorized for FY1992 for the DOT to "ensure the resiliency of the Nation's space infrastructure." This provision, however, does not give DOT the authority to issue grants to State and local authorities. The Senate version of the bill does not contain the \$20 million provision and is awaiting floor action as of September 26, 1991.

On March 7, 1991, Rep. Clay Shaw and Rep. Jim Bacchus introduced H.R. 1358, The Spaceport Financing Act. The purpose of this bill is to amend the Internal Revenue Code of 1986 to treat spaceports like airports under the exempt facility bond rules. Under the bill, interest earned on bonds that were for development of spaceports would be exempt from Federal taxation. The bill has been referred to the House Ways and Means Committee.

On August 3, 1991, Rep. Robert Walker introduced H.R. 3153, the Omnibus Space Commercialization Act of 1991. Title I of the bill contains provisions related to space launch and launch support facilities. The provisions require the Comptroller General to conduct an inventory of all space launch and launch facilities owned by the U.S. Government and identify such facilities that are surplus to public and national security needs. All facilities identified as surplus are to be referred to the General Services Administration for disposition. In addition, appropriate launch facilities are to be designated Commercial Space Centers. Such centers and related activities would be exempt from Federal taxes, duties, and tariffs. Tax-free status would be given to bonds floated for the development of launch facilities in these Commercial Space Centers. The bill also states that the Federal Government shall purchase launch services from commercial providers whenever such services are required in the course of its activities. This provision basically amends provisions on commercial launch services procurement for NASA contained in P.L. 101-611 (see 101st Congress section above) to include the DOD and other Federal agencies. This bill has been referred to the House Committee on Ways and Means and the Committee on Science, Space, and Technology.

The 102d Congress also has continued its interest in issues related to China and the Soviet Union. H.R. 627 introduced January 31, 1991, would prohibit the export of satellites for launch from launch vehicles owned by China. H.R. 934, which was introduced February 19, 1991, contains the same provisions as H.R. 627 but for the Soviet Union instead. Both bills have been referred to the House Foreign Affairs Committee. Pending legislation (S. 320, the Omnibus Export Amendments Act of 1991) would require the President to certify that China is abiding by the terms of its agreement with the U.S. before any more satellites are exported to China. This bill has been referred to the House Foreign Affairs Committee and the House Judiciary Committee. (See Chapter 6 for further information on these issues.)

U.S. GOVERNMENT'S LEAD AGENCY FOR THE COMMERCIAL LAUNCH INDUSTRY

The Department of Transportation

On November 16, 1983, President Reagan issued Executive Order 12465 which identified the Department of Transportation (DOT) as the lead agency for U.S. commercial space launch activities. As established in the Commercial Space Launch Act of 1984, the Office of Commercial Space Transportation (OCST) within the DOT has jurisdiction over the commercial space launch industry. As established in the Act, OCST's responsibilities include: the licensing, regulation and promotion of commercial launch operations; the analysis and establishment of commercial liability limits;¹⁵ and the licensing of site operations at commercial U.S. launch sites. In 1988, the Reagan Administration's National Space Policy reaffirmed DOT as the lead agency in developing, coordinating, and articulating Federal policy and regulatory guidance regarding U.S. commercial launch activities. The Commercial Space Launch Act Amendments of 1988 further defined DOT's role by setting insurance liability limits and requiring DOT to issue insurance requirements for obtaining liability insurance.

DOT's Activities

In accordance with the liability limits set by the 1988 amendments, OCST issued insurance orders for the three largest commercial launch companies. Martin Marietta and McDonnell Douglas are required to obtain insurance in the amount of \$80 million for as long as they continue to use Cape Canaveral facilities for the launch of Titan and Delta vehicles. General Dynamics is only required to demonstrate coverage of \$75 million because the Atlas vehicle does not use solid-propellant rockets.¹⁶

OCST has issued 22 licenses for commercial launches since 1988 (6 of the 22 were for suborbital launches. (See appendix 2.) By September 24, 1991, 22 commercially licensed launches have taken place (15 orbital launches), five have been failures (two of the failures were orbital launches). (See appendix 3.) As of September 24, 1991, eight commercial launches have taken place in 1991 (5 orbital), and six more are scheduled by the end of the year (two orbital). The U.S. Commercial Launch Manifest issued in July 1991 contains listings for 32 commercial launches from September 24, 1991 to 1995 (19 of these are for orbital launches).

Once a launch license application is received, OCST conducts a safety review. Among the issues OCST addresses during a license review are: (1) measures to reduce the potential hazard to the population and property near a launch site during rocket takeoff; (2) selection of a rocket flight path that will not collide with other objects in space; (3) the risks that the rocket's payload

¹⁵ This includes third party insurance, and Government property insurance.

¹⁶ Bulloch, Chris. Commercial Space Launchers--Liability Questions Resolved at Last. Space Markets, Winter 1988. p. 213.

could re-enter the atmosphere and cause damage on Earth if the rocket launch fails; and (4) the level of financial risk the launch provider is responsible to compensate for any destruction to private property near the launch site (third party liability). After the safety of the application's vehicle has been established, the OCST sends the mission plan to NASA, the DOD, the Department of State, the Department of Commerce, and the Federal Communications Commission for comments. The DOD and the Department of State can refuse the application if the DOD deems it a threat to national security or the Department of State feels that the mission goes against U.S. foreign policy interests.

On February 20, 1991, OCST issued its first long-term operator's license to General Dynamics Commercial Launch Services, Inc., to streamline the governmental review process for commercial launches. The operating license will cover all Atlas launches at specific inclinations at Cape Canaveral Air Force Station by General Dynamics for at least two years. It will replace the need to issue separate licenses for each individual launch. Under an operator's license, the approved firm would still be subject to a pre-launch review and Federal user fees. The firm would no longer need advance approval for each specific launch. Inspectors under contract to the Government will conduct periodic inspections of commercial launch preparations over the lifetime of the license. In March 1991, Orbital Science's Space Data Division was granted an operator's license for launch of its Aries suborbital rocket from the White Sands Missile Range, and in May 1991, McDonnell Douglas was granted an operator's license for Delta II launches from Cape Canaveral for two years.

Recently OCST has been developing procedures to license operators of commercial re-entry vehicles which carry experimental payloads from space back to Earth.¹⁷ Private re-entry vehicles are included in OCST's regulatory authority over the commercial launch industry. The interest in licensing commercial re-entry vehicles was prompted by the NASA-funded Commercial Experiment Transporter (COMET) program intended to provide flight opportunities for commercially oriented experiments and prototype hardware using commercially launched and privately developed re-entry vehicles that will return from orbit after 30 days. Utah has been selected as the landing site. The re-entry vehicle for this program is called Westar and OCST is currently engaged in a safety review of the vehicle. OCST's review will set a precedent for such vehicles that may have a larger commercial market in the future.

Commercial Space Transportation Advisory Committee

To assist DOT in developing solutions in response to the commercial launch industry's concerns, the Commercial Space Transportation Advisory Committee (COMSTAC) was established. COMSTAC is an industry advisory group comprised of 22 representatives from the commercial space industry, chartered to provide information, advice, and recommendations to the Secretary of Transportation on Government policies and issues affecting U.S. commercial

¹⁷ Marcus, Daniel J. U.S. Mulls Licensing of Private Re-entry Vehicles. Space News, Jan. 21-Feb. 3, 1991. p. 28.

space transportation. COMSTAC members represent the launch vehicle, satellite, financial, and insurance industries. The advisory group has conducted analyses of launch risks, insurance requirements, use of ballistic missiles as launch vehicles, access to the national launch ranges, and launch vehicle component technology improvements and has submitted reports on these analyses. COMSTAC is an avenue for the commercial launch industry to convey its concerns to OCST, DOD, and NASA.

CHAPTER 2

U.S. GOVERNMENT PROCUREMENT OF SPACE LAUNCH SERVICES

One of the most important ways the U.S. Government influences the competitiveness of the U.S. space launch industry is through its policies and practices for purchasing space launch services. The Government is the single largest consumer of domestic space launch services. Moreover, the economies of manufacturing launch vehicles are such that launch companies cannot afford to run one production line for "Government vehicles" and another for "commercial vehicles." Therefore, to a considerable degree U.S. launch companies must use the same vehicle for commercial launches that they sell to the Government, designing all vehicles to meet Government requirements.

Prior to 1986, most Government payloads were launched by the U.S. Air Force or NASA, which purchased launch vehicles from aerospace companies and acted as the launch operator. Most of these launches were carried out under "cost plus fee" contracts, in which the launch vehicle manufacturer received a set profit and passed its expenses for building the vehicle to the Government. This situation changed in 1986.

Following the *Challenger* accident and a series of ELV failures, the U.S. Government adopted a new space policy that required Government payload operators to use commercial launch services whenever possible; the main exceptions are payloads related to national security, which can be launched by the Government if necessary. As a result of this policy change, a variety of approaches to procure space launch services are used by the Government. The practical effect of these approaches on the competitiveness of launch companies varies considerably.

The approaches currently used by U.S. Government agencies to acquire launch services can be compared in terms of the degree to which they resemble commercial launch contracts. Generally, commercial launch contracts have the following characteristics:

(1) The launch company charges a "firm fixed price"¹⁸ for services, rather than the "cost plus fixed fee" traditionally used by the Government in its procurement of launch vehicles;

(2) The launch company has control and discretion over the design of the launch vehicle and its operating procedures, and can modify the design and procedures as it deems necessary in order to introduce new features to improve efficiency; and

(3) The payload owner has no prerogative to require cost data from the launch provider, and is permitted only "insight" technical data for the purposes of planning and payload integration (as opposed to "oversight" data, which are intended to ensure quality and compliance with specifications)

In addition, many commercial launch contracts provide for a free replacement launch in the event of a failure, and many users of commercial launch services hedge against the risk of failure by purchasing insurance for their payload.

Since the adoption of the 1988 National Space Policy, all Government agencies have attempted to incorporate some commercial elements in their procurement of launch services. There is considerable variation among the approaches.

NASA AND THE PROCUREMENT OF SPACE LAUNCH SERVICES

NASA, in accordance with National Space Policy directives to support and foster commercialization of the domestic ELV industry, competitively procures ELV services directly from the private sector to the maximum extent feasible. The NASA Authorization Act of 1991 (P.L. 101-611) directed NASA to purchase launch services for its primary payloads from commercial launch companies whenever such services are required except when the services are not available, the services would pose an unacceptable risk to the payload, or the payload has national security purposes.

Accordingly, in 1988, NASA began a two-phase transition program to seek, within several years, for U.S. civil Government use, launch services from the U.S. private sector in three launch vehicle performance classes: small, medium, and intermediate. Launch services in the large class of launchers that are not available commercially, but are under DOD contract (Titan IV), will be acquired

¹⁸ Under a firm fixed price (FFP) contract, a company agrees to provide a service to the Government for an agreed charge, no matter whether the company incurs additional costs. The company thus accepts such risks as unexpected technical problems or delays caused by natural phenomena such as weather; there is no guarantee in such cases that the company will make a profit.

through the DOD. Phase I, for launches from 1988 to 1992, involved procurement of launch services on a non-competitive basis. In Phase II, for launches in 1992 and beyond, NASA is procuring launch services on a competitive basis.

NASA Launch Services Contracts

NASA recently awarded two major launch service procurements: the Medium Expendable Launch Vehicle (MELV) and the Small Expendable Launch Vehicle (SELV) programs. Consistent with the National Space Policy, the SELV and MELV procurements are designated as "commercial contracts." Even so, these contracts interpret customer "insight" in terms that allow NASA considerably more data than a customer would be allowed in the typical commercial contract, approximating what is traditionally considered oversight prerogatives. For example, under these contracts NASA is permitted extensive information on the pedigree of the launch vehicle--i.e., documentation on the sourcing of components, the assembly of systems, etc. NASA believes that this level of insight is necessary to limit risks to valuable Government-owned scientific payloads. NASA also has procured a number of individual launches for such payloads as the Combined Release and Radiation Effects Satellite (CRRES) in 1990, the Mars Observer mission in 1992, and the Solar and Heliospheric Observatory (SOHO) mission planned for 1995. In addition, NASA is responsible for procuring launch services for meteorological satellites operated by the National Oceanic and Atmospheric Administration (NOAA). NASA's Commercial Centers for the Development of Space (CCDSs) also contract for commercial launch services for launching commercial experiments on sounding rockets and launches to low Earth orbit (LEO).¹⁹

Currently, when NASA enters into contracts with the commercial launch industry, the contract involves a firm fixed price and can extend over a five year period. The contract provides for a firm number of launches with options for planned missions that may be approved in the future. Launch service orders are pre-priced by quantity and delivery date with new orders being placed each January. NASA's commercial launch service acquisition strategy allows the Government to order additional launch services after a basic contract for services has been competitively selected. NASA is including a provision in all its commercial contracts that guarantees price reductions to NASA if the contractor sells substantially the same service to any other buyer at a lower price. In addition, the contracts also include provisions which automatically lower the price of launch services to NASA each time one or more of the vehicles are added to the contracted commercial operator's production. NASA's commercial launch service acquisition strategies seek to simplify and streamline procurement requirements consistent with the Federal procurement policy and applicable Federal acquisition regulations (FARS). The NASA strategy also allows flexibility in considering new U.S. offerings of commercial launch services.

¹⁹ NASA's Office of Space Science and Applications conducts its own sounding rocket launches for university experiments.

In its current contracts with commercial launch firms, NASA retains a large share of launch responsibilities. NASA chairs the integrated mission readiness review team and is responsible for spacecraft integration and mission analysis, independent verification and validation, flight readiness assessment, launch concurrence,²⁰ and contract terms assessment. The launch provider is responsible for the production of the vehicle, the integrated systems test, launch site vehicle assembly and tests, launch countdown, and post flight mission analysis. The contractor makes its own arrangements for use of facilities or other assets for the launch. The acceptance of total launch service occurs when the satellite has attained its proper orbit. The following table lists the usual areas of NASA approval and insight in a launch services contract.

NASA Approval/Insight in Launch Services Contracts	
Requires NASA Approval	Allows NASA Insight
Mission Integration	
-Spacecraft to launch vehicle interface control documents/drawings -Decisions/Resolutions of action items from U.S. Government and contractor -Mission peculiar hardware design, analysis, and test -Mission peculiar software design, analysis and test	
Production	
-Inspection, test and acceptance requirements* -Systems effectiveness plan and changes*	-Production program review -Flight hardware pedigree reviews -Safety, reliability, and quality assurance compliance and spot audits -Pre-ship review -Qualification reviews -Major/critical problems
Integrated Systems Tests	
-Test plan, requirements, and success criteria* -Systems effectiveness plan and changes*	-Major systems test -Post-test data reviews -Anomaly resolutions -Failure analysis -Major/critical problems

²⁰ Launch concurrence is the decision to proceed with the launch, or delay or postpone the launch until conditions allow the launch to proceed.

NASA Approval/Insight in Launch Services Contracts (cont.)	
Requires NASA Approval	Allows NASA Insight
Launch Vehicle Assembly and Test	
-Test plan, requirements, and success criteria* -Systems effectiveness plan and changes*	-Launch site support reviews -Vehicle walkdown inspection -Safety, reliability, and quality assurance compliance and spot audits -Review of operations and procedure discipline -Review of work practice/documentation -Post-test data reviews -Anomaly resolutions -Failure analysis -Work schedules/plans -Vehicle launch commit criteria -Vehicle flight readiness review
Integrated Spacecraft/Vehicle Operations and Launch	
-Integrated mission readiness review (chair) -Integrated vehicle/spacecraft assembly and test procedure -Spacecraft go/no-go -Launch concur/non-concur	-Major integrated systems tests -Anomaly resolution -Failure analysis
Post-Flight Mission Analysis	
-Determination of mission success	-Flight vehicle data review -Tracking and range data review -Anomaly investigation/closeout review

Prepared by CRS from information provided by NASA.

Note: * Baseline in launch services contract

Medium Expendable Launch Vehicle (MELV). In December 1990, NASA awarded its MELV contract to McDonnell Douglas for the Delta II. The contract acquires launch services for three NASA satellites scheduled for launch in 1992 and 1993.²¹ The \$140.6 million contract also contains pre-priced options for twelve additional launches over the following five years and launch pad modifications at Vandenberg Air Force Base. Although the contractor will be providing launch services, NASA maintains oversight, inspection, modification clauses and documentation, and access requirements.²²

²¹ The three scientific satellites are: Geotail, planned for launch in July 1992; Wind, planned for launch in Dec. 1992; and Polar, planned for launch in June 1993.

²² According to General Dynamics, May 1991.

Small Expendable Launch Vehicle (SELV). The SELV was NASA's first commercial ELV launch solicitation that involved real competition. NASA awarded its SELV contract to Orbital Sciences Corp. (OSC) in March 1991 for the Pegasus air-launched vehicle. The \$80 million contract requires seven launches from 1993 through 1996, with options for three additional launches of Small Explorer (SMEX) class payloads. The SELV contract includes several commercial-style elements not found in previous NASA procurements for launch vehicles. Under the SELV, NASA's ability to require data from the contractor is limited; it is permitted insight and cost data, but it is not permitted documentation concerning compliance with Government specifications. The contract uses overall performance requirements defined by NASA, rather than the detailed vehicle specifications contained in previous contracts. The contract also describes the deliverables by the contractor as "launch services" and not launch hardware or vehicle.²³ Notwithstanding these commercial elements under the SELV contract, NASA still retains many of the prerogatives found in previous solicitations. As noted, although NASA maintains these are commercial contracts, NASA has expanded its prerogatives for insight data into what is in some cases "oversight," or data required for quality assurance.

Other NASA Launch Service Procurements. NASA is also responsible for the procurement of launch services for the NOAA and GOES series of weather satellites operated by NOAA. The NOAA series of polar-orbiting satellites are launched on Air Force-provided Titan IIs. These launches are considered Government, not commercial, launches. The geostationary GOES satellites will use an Atlas I. Originally scheduled as Government-operated launches, General Dynamics proposed the use of commercially procured launches instead. The final contract for the GOES launches is a modification of the standard General Dynamics commercial launch contract, retaining the main provisions of a standard commercial contract, but allowing NASA greater prerogative than usual for data concerning the design and manufacture of the launch vehicle. The GOES launches will still be considered Government launches, however, since NASA will indemnify them.

NASA also has a contract with Martin Marietta for the launch of the Mars Observer scientific spacecraft on a Titan III in 1992. This launch is considered a commercial launch as NASA will be indemnifying the launch.

Commercial Centers for the Development of Space (CCDS). Commercial Centers for the Development of Space are NASA/university/industry non-profit partnerships whose objective is to act as a transfer point for space science, applications, and technology to industry. Of the 16 CCDSs, eight centers are interested in materials research and processing in space that may require the use of sounding rockets and launches to LEO. The contracts for launch services awarded by the CCDSs are purely commercial contracts. In 1988, the Center for Materials Development in Space at the University of Alabama at Huntsville awarded a commercial contract to Space Services, Inc.,

²³ U.S. National Aeronautic and Space Administration. Small Expendable Launch Vehicle Services. Goddard Space Flight Center, Greenbelt, MD, RFP5-65953/551.

for the suborbital launching of microgravity experiments using its Starfire sounding rocket. The award was for three firm launches and unspecified options for additional launches. Three launches under this contract have taken place (one failed), and the CCDS has taken a fourth option for the launch of a Starfire in September 1991. In 1989, Space Data, a division of Orbital Sciences Corp., won a contract from the CCDS at Huntsville for four Joust microgravity payloads to be launched from Cape Canaveral on the Prospector sounding rocket. The first Prospector launch ended in failure June 18, 1991. The second Prospector launch of a Joust payload has been rescheduled for May 1992.

In 1991, the CCDSs established a new program for longer duration experiments in space called the Commercial Experiment Transporter (COMET). As discussed earlier, the COMET program is intended to provide flight opportunities for commercially oriented experiments and prototype hardware from the CCDS. It will use an expendable rocket to launch a service module plus recovery system (together they are called a free-flyer). The specifications for the service module refer to a 100-day nominal mission, while the recovery system would typically separate from the free-flyer after about 30 days on orbit to return experimental materials to Earth. In February 1991, EER/Space Services was awarded a strictly commercial contract by the Center for Advanced Space Propulsion CCDS at the University of Tennessee Space Institute, Tullahoma, TN, to launch the COMET capsule with the Conestoga launch vehicle. The contract is estimated to be worth \$45 million and includes three flights and options for two more. The first flight is scheduled in September 1992 from Wallops Island.

Facility Use and Service Agreements

In addition to undertaking a transition to competitively procure launch services, NASA has responded to ELV commercialization goals by developing agreements under which private sector operators may use NASA's ELV property and services. The agreements with NASA headquarters authorize industry to negotiate with the appropriate NASA field centers in order to obtain sub-agreements in which NASA will provide, on a cost-reimbursable basis, access to agency launch support property and services that are not available from commercial sources. The sub-agreements cover NASA's Kennedy, Langley, Lewis, Goddard, and Marshall installations. Thus far, six headquarters agreements have been signed.²⁴ NASA's most recent agreement was signed July 3, 1990, with Orbital Sciences Corporation (OSC) in support of the firm's Pegasus and Taurus commercial launch vehicle programs. The agreement allows OSC to use NASA's B-52 airplane for Pegasus launches and allows the firm to enter into specific sub-agreements with NASA installations.

²⁴ Headquarters agreements have been signed with General Dynamics for the Atlas launch vehicle, McDonnell Douglas for the Delta launch vehicle, Martin Marietta for the Titan launch vehicle, LTV Corporation for the Scout vehicle, Space Services, Inc. (now a division of EER Systems Corp.) for the Conestoga launch vehicle, and Orbital Sciences Corp. for its Pegasus air-launched vehicle.

DOD AND THE PROCUREMENT OF SPACE LAUNCH SERVICES

After *Challenger*, the Department of Defense decided to remove virtually all national security-related payloads from the shuttle. The 1987 DOD Space Policy specifies that expendable launch vehicles provide its primary launch capability.²⁶ The Defense Science Board (DSB) has studied the advisability of the DOD purchasing commercial launch services to promote the commercial industry in lieu of normal acquisition of launch vehicles. It became clear to the DSB that the demand for launching commercial payloads alone, not including DOD, was insufficient to support the launch vehicle industry. DOD's requirements, however, are essential to the maintenance of economic production lines for Delta, Atlas, and Titan. The DSB had reservations, however, about DOD purchasing commercial launch services. Although such an approach might be warranted in selected cases, applying the concept of commercial launch services across the board would have the effect of the DOD relinquishing control to the commercial firm over access to space. The Board felt uncomfortable with the view that half-billion dollar national security payloads could be turned over to a purely commercial operation with no hands-on involvement by the Air Force. Since the concept of purchasing commercial services is relatively new to the DOD, DSB believes that the trade-offs and applicability of using commercial services deserves more thorough study before a firm DOD position can be developed.

Since the adoption of the 1988 National Space Policy, the DOD has attempted to incorporate some commercial elements in its procurement of launch services. There is considerable variation among the approaches used by the services within DOD. At one extreme, the Air Force procurement of Titan, Atlas, and Delta launches is essentially similar to traditional procurement methods, except for use of a firm fixed price and performance incentive payments. At the other extreme, the Navy allowed its payload contractor to obtain launch services for its UHF Follow-On communications satellite, and did not directly participate in the procurement.

Air Force

The Air Force uses four types of orbital launch vehicles: Titan IV, procured from Martin Marietta through the Complementary Expendable Launch Vehicles (CELV) program; Delta II, procured from McDonnell Douglas through the Medium Launch Vehicle (MLV) program; Atlas II, procured from General Dynamics through the MLV-2 program; and the Pegasus air-launched vehicle, procured from Orbital Sciences Corporation (OSC) through the Air Force Small Launch Vehicle (AFSLV) program. The provisions of each of these differ significantly.

Titan IV (CELV). The original purpose of the CELV program was to provide an alternative to the shuttle for launching the Government's largest

²⁶ Report of the Defense Science Board 1989 Summer Study on National Space Launch Strategy (U), Mar. 1990. Office of the Under Secretary of Defense for Acquisition, Washington. p. 6.

payloads. The contract was won by Martin Marietta, whose Titan IV is an evolution of the Titan III and Titan 34D that the company had previously sold to the Air Force. The Titan IV contract included some commercial-style provisions that intended to provide Martin Marietta incentives to provide a more reliable vehicle. Under the provisions of the contract, Martin Marietta provides the vehicle to the Air Force at a fixed price. In addition, the company is paid a \$7 million bonus for each successful flight. The company is obligated to pay a \$45 million penalty for each failure.²⁶ In other respects, however, the Titan IV contract follows the traditional, non-commercial mold. In particular, the design characteristics of the launch vehicle are specified by the Government. As part of the effort to improve the reliability of U.S. launch vehicles that was instituted in 1986 after the loss of several ELVs, the specifications for the Titan IV were reviewed in detail and modified as was found appropriate. Also, the Government holds the title to the vehicle. The original 1985 contract for the CELV program provided for the procurement of 10 vehicles; this has since been increased to 41 Titan IVs with an option for eight additional vehicles at a total cost of \$7.5 billion. The Air Force expects to launch 61 of the boosters through the year 2001.²⁷ As of September 1, 1991, five Titan IVs have been launched.

Delta II (MLV-1). The MLV-1 contract, worth at least \$669 million, was awarded to McDonnell Douglas in November 1986 for its Delta II launch vehicle. The contract calls for 11 firm orders for vehicles with an option for 20 more. As of September 1, 1991, eleven Delta II launches have taken place under this contract. The launches were primarily for the DOD's Global Positioning System (GPS) satellites. Like the CELV program, the MLV-1 contract retains many of the traditional elements of previous Air Force procurements of launch vehicles. As in the case of the Titan IV, the Government holds the title to the launch vehicle. The vehicle is also subject to Government design specifications. Yet, as in the case of the CELV program, the MLV-1 contract is a firm fixed-price contract. The MLV-1 contract also included performance incentives intended to reduce risks to the Government. Under the terms of the contract, McDonnell Douglas receives a \$3 million bonus for each successful launch, and a \$1 million award each year for five years if the company meets all contractual obligations. However, in the event of a single failure, McDonnell Douglas forfeits all bonuses. After two failures, the company loses all expected profits.²⁸

Atlas II (MLV-2). The MLV-2 program was intended to provide the Air Force additional medium ELV launch capability. The MLV-2 contract was awarded in 1988 to General Dynamics for its Atlas II vehicle. The MLV-2 contract, worth at least \$340.5 million, currently provides for four firm launches and options for seven additional launches. These vehicles will be used to launch

²⁶ Air Force, Contractors Predict Long Life for Heavy Lift Vehicle. *Aviation Week and Space Technology*, July 17, 1989. p. 32.

²⁷ Kiernan, Vincent. Fewer Eyes in Skies. *Space News*, Apr. 22-28, 1991. p. 4.

²⁸ Information provided by McDonnell Douglas, May 1991.

DSCS-3 communications satellites and a P87B experimental satellite.²⁹ The MLV-2 contract introduces even more commercial-style measures than the CELV and MLV programs. The Air Force takes title to the launch vehicle once it leaves the launch pad; under previous Air Force contracts, the Government-owned and held title to a launch vehicle from the time of manufacture. The MLV-2 contract incorporates tailored specifications which permitted General Dynamics to propose its Atlas II, which had already been designed for commercial use. A final commercial-style provision in the contract states that in the event of a launch failure, the Government is guaranteed a free re-flight.

Pegasus (AFSLV). In April 1991, the Air Force awarded its AFSLV contract to Orbital Sciences Corporation (OSC) for its Pegasus air-launched and derivative vehicles. The contract covers one firm launch at an estimated cost of \$10 million with options for 39 additional launches. The first launch is planned for late 1992. The program is aimed at providing launch services for small defense satellites for research and operational purposes.

Strategic Defense Initiative Organization (SDIO)

SDIO has used a variety of launch services, usually procured on a case-by-case basis. The specific terms under which these services are purchased vary considerably. For example, LOSAT, a dual-satellite payload launched in February 1990, was the first OCST-licensed commercial launch of a DOD payload. In this case, SDIO procured the launch on a commercial basis from McDonnell Douglas. The basic provisions of the LOSAT Request For Proposal (RFP) were the same as those used by NASA in its SELV and MELV RFPs. In the case of the requirements for documentation and insight, the three RFPs were identical. On the other hand, in its MSX mission (yet to be launched), SDIO purchased launch services from the Air Force on an upgraded Titan II vehicle. The Titan II is a converted ICBM owned by the Air Force. Martin Marietta will pay the nonrecurring costs of modifying the vehicle.³⁰ The launch will be conducted by the Air Force as a Government-supervised launch.³¹ In November 1989, SDIO contracted with Space Data, a division of Orbital Sciences Corp., for commercial launches of its Aries sounding rocket. The contract is for 10 firm launches, with unspecified options for several more.

Defense Advanced Research Projects Agency (DARPA)

DARPA has solicited proposals for launch services in connection with its Advanced Satellite Technologies program, more commonly known as "Lightsat." The purpose of Lightsat is to demonstrate the feasibility of small, inexpensive

²⁹ USAF Selects General Dynamics As Medium Launch Vehicle Supplier. *Aviation Week and Space Technology*, May 9, 1988. p. 17.

³⁰ These modifications consist mainly of the addition of eight solid rocket boosters.

³¹ New SDI Surveillance Satellite to Use Upgrades of Titan II Booster. *Aviation Week and Space Technology*, Sept. 25, 1989. p. 31.

satellites for military applications. To support this program, DARPA has sponsored the development of small launch vehicles and acquired launch services from the companies developing these systems.

Air-Launch Vehicle (ALV). DARPA awarded a development contract to Orbital Sciences Corporation (OSC) and Hercules Aerospace Company in a joint venture to develop the three-stage Pegasus air-launched vehicle (ALV). Although development of the vehicle has been privately funded by Orbital Sciences and Hercules, DARPA has supported the development of the vehicle by contracting for the first launch with five optional launches. The first launch occurred on April 4, 1990, and as of April 1991, DARPA had converted all of the launch options to firm launches. DARPA solicited the Pegasus launches through a Broad Agency Announcement (BAA) seeking a "generic air-launch" capability. OSC serves as prime contractor and systems integrator. The vehicle is assembled by a multi-contractor team. Range support systems are provided by DARPA, and the launch aircraft (B-52) is provided and operated by NASA. The launch is initiated by the NASA crew.³²

Standard Small Launch Vehicle (SSLV). DARPA has also awarded a contract to Space Data, Inc., a subsidiary of OSC, for the development of a new launch vehicle capable of quick reaction launches. The vehicle, called Taurus, is designed to consist of a Pegasus-derived booster mounted on stages of the MX ballistic missile. The objective of this program, called the Standard Small Launch Vehicle (SSLV), is to develop a vehicle capable of launching small military payloads with three to eight days of preparation, in contrast to the months of preparation required by current systems.

U.S. Navy

The Navy's approach to the procurement of launch services differs greatly from that of the Air Force and NASA. In effect, the Navy uses an approach to purchasing launch services that is identical to that used by commercial satellite operators. In the case of the UHF Follow-On, the Navy has not procured a launch service at all; rather, its contract with the satellite manufacturer, Hughes Aircraft, stipulates that Hughes procure the launch itself. Under this approach, the Navy has no prerogative to request data pertaining to the compliance of the vehicle to Government specifications. The Navy/Hughes contract could involve as many as ten commercial launches by General Dynamics using the Atlas launch vehicle. The launch rate is planned at three per year starting in 1992.³³

According to Air Force analysis, if the Atlas rocket is as reliable as it has proven over time, the Navy would have saved money by buying Atlas launch vehicles through the Air Force instead. However, if two launch failures occur,

³² Pegasus Air-Launch Test Vehicle is Rolled Out. *Aviation Week and Space Technology*, Aug. 14, 1989. p. 36.

³³ GD Will Launch First UHF Follow On Satellite. *Aviation Week and Space Technology*, Aug. 21, 1989. p. 22.

the program would be cheaper than if they had bought the vehicles through the Air Force.³⁴

³⁴ Air Force Rejects Commercial Launches. Military Space, July 29, 1991. p. 6.

CHAPTER 3

U.S. LAUNCH INFRASTRUCTURE

U.S. commercial launch firms currently rely upon the existing national launch infrastructure to support their operations. U.S. firms offering launch services are able to offer only the launch vehicle itself and the technical support required to prepare the vehicle for operation; they do not own their own launch sites. In accordance with National Space Policy, the U.S. Government provides for the use of national launch sites, property and services on a direct cost reimbursable basis.³⁵ General Dynamics, Martin Marietta, and McDonnell Douglas have generally paid \$2-3 million per launch in direct cost fees for using U.S. Government launch sites, property, and services.³⁶

U.S. LAUNCH FACILITIES

Launch Sites. The U.S. Government operates four main launch ranges that are used or may be used for commercial launches: The Air Force's Vandenberg Air Force Base in California (34.7°N, 121°W); the Army's White Sands Missile range in New Mexico (32°N, 106°W); NASA's Wallops Flight Facility in Virginia (37.9°N, 76°W); and the Air Force's Cape Canaveral Air Force Station in Florida (28.5°N, 88°W). Only two of these are capable of supporting launch operations for orbital launches using large capacity ELVs--Cape Canaveral and Vandenberg. The Air Force and NASA have developed

³⁵ Direct costs are those that can be unambiguously associated with commercial launch efforts, and which the Government would not incur in the absence of those launch efforts. These include: operation and maintenance costs which includes consumables and utilities which are applicable only if equipment or facility is assigned to a commercial operator for a period of time; wear and tear costs which are applicable only when dominating factor leading to replacement is associated with usage by the commercial operator; equipment or facility modification costs when modification is to meet the unique needs of the commercial operator; and, labor costs which includes civil service and contractor salaries involved with the operations.

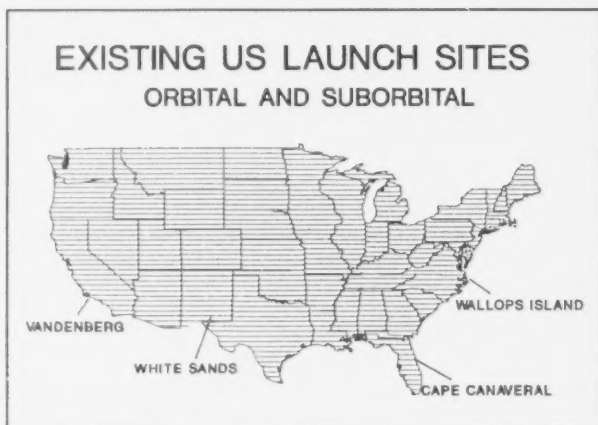
³⁶ According to a McDonnell Douglas spokesperson, Apr. 1991.

Model Range Use Agreements governing the commercial use of their facilities.³⁷ (See appendix 6.) Smaller capacity ELVs and sounding rockets have greater options for launch facilities. In addition to Cape Canaveral and Vandenberg, the NASA facility at Wallops Island and can be used for small orbital vehicles. The Army's White Sands Missile Range can only be used for suborbital sounding rocket launches.³⁸ The Air Force Space Command is now responsible for operating the facilities at Cape Canaveral and Vandenberg (previously they were operated by Air Force Systems Command's Space Division).

Launch Support.

The national launch sites are more than just launching pads. The sites' capabilities include radars, telemetry receivers, optical trackers, communications, and data processing centers, most of which are required to support commercial space launch activities. Embodied in these range capabilities are other services: range safety, engineering, and weather forecasting.

Range safety ensures that all processing and launch activity is conducted in a manner that protects the general public and critical national resources. Engineering is responsible for ensuring that launch pad and processing facilities configurations are maintained, and that any new or modified facilities meet requirements. The range also provides weather forecasting support and specially trained crews and facilities to manage hazardous fuels. Most commercial customers use all these capabilities. The services supplied by the national launch sites do not come free, and there has been a great deal of interest in the pricing policy that has been developed. The Europeans are



³⁷ The Model Range Use Agreements were developed pursuant to the authority of the Commercial Space Launch Act of 1984, the NASA Act, and the Military Leasing Act. The Model Range Use Agreements were last revised May 3, 1989.

³⁸ Sounding rockets are small rockets that launch payloads that are not to be put into orbit. They are primarily used for microgravity experiments. Other ranges in the United States that can support sounding rockets include: Pacific Missile Range Facility at Barking Sands, Hawaii; Eglin Air Force Base, Florida; Greenriver, Utah; Kwajalein, Marshall Islands; Tonapath, Nevada; and Poker Flat Research Range, Alaska. All of these ranges are Federally owned except for Poker Flat Research Range, which is owned by the University of Alaska. As of September 1991, two commercially licensed sounding rocket launches have occurred at the Pacific Missile Range Facility at Barking Sands. In addition Poker Flat Research Range is looking into the possibility of upgrading its facilities to allow for orbital commercial launches.

concerned that the facility pricing policy will serve as a subsidy to U.S. commercial firms. The Air Force policy is that it will not make or lose money and will use existing accounting/management systems whenever possible to avoid additional overhead costs.

Launch Manifesting. The Air Force has developed an integrated manifesting system that encompasses both commercial and Government launches. Government and commercial launches are scheduled on a first-come-first-served policy. The integrated scheduling concept continues from the Air Force Space Command to the range where scheduling must take into account all the activities that occur at a launch site that may include ballistic missile test launches. Concern has been raised about preemption of commercial launches where Government and commercial launches are supported by the same facilities. According to the Air Force, commercial launch efforts will be accorded a high degree of stability. However, the U.S. Government will have priority use of Government facilities and support services to meet national security and critical mission support requirements. Launches necessary to preserve and protect human life in space shall have the highest priority except in times of a national security emergency. With respect to commercial use of Government facilities and services, the U.S. Government is to make all reasonable efforts to minimize adverse impact on commercial operations.³⁹ The Air Force policy is to provide the commercial firm a place in line, or launch slot, of three months. The firm is expected to manage its resources in order to launch during the given launch slot so that other commercial and Government launches are not delayed.

Launch Safety. Safety is another area that has generated interest. The Air Force has levied the requirement that all commercial launches using the national ranges meet the criteria of Air Force regulation 127-1, the same regulation applied to all DOD launch systems that use the ranges. While it has leased out the actual launch pads and preparation facilities to the commercial operators, the Air Force still retains full responsibility for range safety. This means that it will remain the task of an Air Force Range Safety Officer to determine whether a launch may take place; to ensure that there are no ships or aircraft at risk downrange of the launch site; to plot the areas progressively at risk; and to maintain and observe the destruct lines for launch abort. While the Range Safety Officer will be aware that the launcher and its payload are private property, the flight will be aborted if third parties are about to be exposed to risks determined as unacceptable under existing Air Force rules.

DEVELOPMENT OF COMMERCIAL SPACEPORTS

State Initiatives. A recent development in the area of launch infrastructure has been the stated intentions of several States to consider construction of commercial spaceports. A commercial spaceport is a launch site that is developed with private funding or through a public-private funding partnership. Such a launch site would then be operated by a private firm and used only for commercial launches. The concept of developing commercial spaceports has been gaining momentum in the past couple of years as some U.S.

³⁹ National Space Launch Program Report to Congress, Mar. 14, 1989.

States have begun investigating launch site development. Commercial spaceports have been proposed by the States of Florida, Hawaii, Virginia, and Alaska, with Mississippi and California also showing interest. In addition, in NASA's FY1991 Authorization Act (P.L. 101-611), Congress amended the Commercial Space Launch Act of 1984 recognizing the importance of space launch infrastructure and State governments' role in developing commercial spaceports. State governments are interested in developing spaceports because they view publicly assisted spaceport development as a way of attracting high technology space industry and jobs. These States see potential future growth in space commerce, and if they are able to develop launch infrastructure in the near-term, they believe they would have a competitive advantage over other States in attracting future space commerce business.

Florida. In 1988, the State of Florida commissioned a feasibility study on the prospects for commercial spaceports. This study, which was released in February 1989, identified potential launch sites and urged State officials to move quickly on a spaceport initiative. The 1989 study identified three unused launch pads at Cape Canaveral Air Force Station and a site north of NASA's adjacent Kennedy Space Center as potential sites for a commercial spaceport. The site north of Kennedy Space Center was eliminated from future consideration because of environmental concerns. The use of the unused pads at Cape Canaveral is also questionable because the Air Force may have a potential future use for them. Although development of these pads would offer modernized facilities, security procedures may not be eliminated because the pads would still be located on the Air Force range. Discussions with the Air Force for use of the old pads are ongoing.

In June 1989, the Florida legislature created the Spaceport Florida Authority (SFA). The Authority is the sole regulator of commercial spaceports in the State, and is responsible for ensuring, through active cooperation with federal agencies, the space industry, and academia, that a supportive environment exists in Florida for the growth and continued development of space activities, including launch activities, other space business, research, and education.⁴⁰ The Spaceport Florida Authority Act (Chapter 331, Florida Statutes) extends State sales and use tax exemptions to include commercial launch vehicles, fuels, and payloads, and also empowers SFA to issue bonds to finance the development of space-related projects. SFA has authority to issue bonds worth up to \$500 million.⁴¹ Near-term plans of the Authority are focused on establishing a foothold in small-payload suborbital launches and updating commercial launch infrastructure at Cape Canaveral.

In August 1990, the Authority issued \$25 million in bonds for General Dynamics to upgrade and expand Atlas rocket launch equipment at Cape Canaveral. The amount was later raised to \$50 million. SFA has also approved

⁴⁰ Statement of Edward A. O'Connor, Jr., Executive Director, Spaceport Florida Authority, before the House Science, Space, and Technology Subcommittee on Space, July 17, 1991.

⁴¹ These bonds are exempt from State or local government taxes.

a \$207,680 proposal from Orbital Sciences Corporation (OSC) of Virginia to initially operate a planned suborbital launch complex at Cape San Blas and provide six Super Loki suborbital rockets. Cape San Blas is an Air Force suborbital launch site that has been deactivated. Discussions with the Air Force for long-term access to the facility are ongoing. The first launch from the complex was planned in May 1991 for the Florida State University meteorology department, but delays in getting environmental permits for the launches have pushed the first launch at Cape San Blas until late 1991. SFA did launch a Super Loki from Tuxpan, Mexico on July 11, 1991, to view phenomena from a total solar eclipse. The payload for this launch was developed by the Florida Institute of Technology. The launch was a success, but a payload malfunction prevented the reception of any data.

Hawaii. Interest for a launch site in Hawaii originally came from Japan. The Japanese government has an agreement with Japanese fishermen that limits Japanese launches to two per year from each of the country's two launch sites (See Chapter 7 for a discussion of Japanese launch capabilities.). Japanese use of a spaceport in Hawaii would give the country additional options for launches in the future. In his 1987 State-of-the-State address, Hawaiian Governor John Waihee announced the possibility of developing a commercial spaceport in Hawaii. In April 1988, the State of Hawaii completed a feasibility study and made the preliminary selection of Palima Point and Kahilipali Point on the southeastern coast of the Island of Hawaii as two potential commercial space launch sites. The Hawaii spaceport is envisioned as an international facility designed to service ELVs in the small and medium lift capacity categories. Hawaii plans to locate the spaceport within a foreign trade zone to allow for the launch of foreign vehicles and satellites without the need for U.S. Customs duties. Hawaii's location allows for launches into either polar or equatorial orbits. The State's objective is to prepare the way for an international consortium of private developers to fund, design, construct, and operate the launch facility.

In July 1988, the State also created two small organizations, the Hawaii Space Development Authority (HSDA) and the Office of Space Industry (OSI), to deal with the growing interest in space commerce. After approval of funding by the legislature, the State began studies to prepare a master plan for spaceport development. In the summer of 1989, Hawaii requested a preliminary safety determination of the two sites from the Department of Transportation's Office of Commercial Space Transportation (OCST). OCST conducted a study and determined that both sites are acceptable from a safety perspective as candidate commercial launch sites. This determination allowed OSI to proceed with an Environmental Impact Study (EIS) with the reasonable assurance that the selected sites do not pose problems from a safety perspective. The EIS process began in September 1989, with joint participation from the State of Hawaii and OCST.⁴² The EIS is expected to be completed in 1991, and may recommend one of the two potential sites. If a decision is made to proceed with a site, the State would begin land-use control and acquisition procedures as early as 1992. Some concern about the sites' potential effect on the sugarcane

⁴² OCST is overseeing the development of the EIS at the cost of \$2 million.

growers in the area has been raised, but the State currently feels that potential effects, if any, would be limited.

Virginia. The Commonwealth of Virginia has also been exploring the feasibility of establishing launch sites dedicated to commercial launches at either a Federal or non-Federal location within the State. In particular, Virginia's Center for Innovative Technology (CIT) has been investigating the commercial potential of NASA's Wallops Island Flight Facility on Virginia's Eastern Shore. Wallops has been used in the past by NASA for suborbital sounding rockets and orbital Scout ELV launches. CIT was established in 1984 by Virginia's General Assembly to serve as a catalyst between industry and Virginia universities, and to provide technical, research and development, and business assistance to industry. CIT's Space Industry Development Program represents ten percent of CIT's overall effort.⁴³

Since 1989, CIT has examined potential costs, benefits, and institutional barriers associated with the commercialization of Wallops. CIT's strategy has been that before any commercial activity could be conducted at Wallops, a clearly identifiable market for commercial launch services must exist that could be served by the Wallops facility.⁴⁴ CIT believes that such a market is now evident and is currently exploring actions which the agency might take to make Wallops an attractive option for the commercial launch industry. The creation of an organization that would develop and manage a commercial spaceport in Virginia is also being explored.

Alaska. Alaska is interested in further developing the Poker Flat Research Range which is owned by the Geophysical Institute of the University of Alaska Fairbanks and used for scientific and meteorological suborbital launches. Range operations are currently funded by NASA, and for the past two years, NASA and the DOD have been working with the range managers to develop a comprehensive improvement and modernization program for the range. The Alaska Industrial Development and Export Authority is currently funding an assessment of Poker Flat to determine the feasibility of commercial launches of low altitude polar orbiting satellites from the site. This assessment is due to be completed in December 1991.

In July 1991, Alaska established a spaceport authority called the Alaska Aerospace Development Corp. (AADC) aimed at attracting business for a civilian launch pad. AADC has the responsibility to nurture commercial development, to provide facilities and economic support for commercial space launch activities, and also to provide support to the research and education mission of the

⁴³ Testimony of Stephen Lee Morgan, Director, Space Industry Development Center for Innovative Technology, before the House Science, Space, and Technology Subcommittee on Space, July 17, 1991.

⁴⁴ Ibid.

University of Alaska as it relates to space.⁴⁵ The authority will receive \$302,500 in State funds for the first year and will be able to issue revenue bonds to improve the site.

Other Interested U.S. States. The States of California and Mississippi have also shown interest in developing commercial spaceports. California is interested in developing a commercial spaceport at or near launch facilities at Vandenberg. Such a facility may use infrastructure that is already located at Vandenberg. Mississippi has also shown interest in developing a launch facility on the southeast coast of the State on the Gulf of Mexico in either Hancock or Harrison counties. OCAST has visited the potential sites in Mississippi and has completed a feasibility study of three proposed launch sites.

Congestion Reduction and Facility Modernization. Spaceport development is also considered a potential way to assist the competitive stance of the emerging U.S. commercial launch industry. Commercial spaceport development has been proposed as an alternative for reducing congestion at U.S. Government launch sites and obtaining modern launch facilities that may enhance U.S. launch industry competitiveness. At the existing national facilities the needs of the DOD, NASA, and commercial customers must be balanced. The majority of U.S. commercial launches take place from Cape Canaveral Air Force Station. Many in industry believe the Cape Canaveral launch facilities are crowded and outdated resulting in a commercially unattractive environment.⁴⁶ According to Air Force officials the U.S. launch facilities are in dire need of repairs and improvements that could cost as much as one billion dollars over the next decade.⁴⁷ Some of the discrepancies, if not corrected, could result in mission failure during spacecraft processing, launch, and tracking and associated operations.⁴⁸

Operation by the Air Force also leads to security measures that may further limit commercial attractiveness. Without the development of new spaceport facilities or the improvement of current facilities, some feel the U.S. commercial launch industry cannot insure that their services will be competitive in the future. A new commercial spaceport could provide modernized facilities and equipment, which would benefit the commercial launch industry. It is envisioned that such a spaceport would be managed by a commercial firm that

⁴⁵ Statement of Merrit R. Helfferich, Associate Director for Institute Relations, Geophysical Institute, University of Alaska Fairbanks, before the House Science, Space, and Technology Subcommittee on Space, July 17, 1991.

⁴⁶ Lee-Miller, Stephanie. Refocusing for Competitive Excellence. Ad Astra, Jan. 1991. p. 41.

⁴⁷ Kiernan, Vincent. A.F. Launch Pad Work Needed in 1990s. Space News, Nov. 21-Dec. 2, 1990. p. 1.

⁴⁸ Kolcum, Edward H. USAF Civil Engineering Report Prompts Major Repairs to Delta Launch Complex. Aviation Week & Space Technology, June 24, 1991. p. 52.

would not be obliged to follow many of the security procedures that Federal ranges find necessary. Development of unused launch facilities at current Federal ranges, however, may not eliminate the security procedures.

CHAPTER 4

MARKET FOR SERVICES

The demand for commercial launch services comes from two main sectors: the commercial market and Governments. An estimation of the market from these two sectors consists of a variety of existing and planned payloads that include satellites for communications, navigation, earth observation, microgravity experiments, and scientific activities. The payloads in these areas require the use of ELVs of different capabilities, from small suborbital sounding rockets to large capacity launch vehicles.⁴⁹

Estimating the size of the market is extremely difficult. For communications satellites, for example, new technologies such as fiber optic cables may shrink the demand for satellite links. Alternatively, new satellite technologies such as direct broadcast television and mobile communications may increase it. The demand for commercial satellite launches is inherently unpredictable, yet it is critical in assessing the future of commercial launch services. The market estimates do not include the vast majority of satellites that will be launched, since most countries with their own launch capabilities tend to launch their own spacecraft. U.S. Government satellites must be launched on U.S. launch vehicles (unless a waiver is granted); Soviet and Chinese satellites are launched by those countries; and so forth. If those markets were opened to commercial launch service providers, the prospects for the industry could be quite different.

COMMERCIAL PAYLOADS

Estimates by U.S. and foreign launch service providers indicate that U.S. commercial and foreign demand for large capacity launch services to

⁴⁹ For a more information on the commercial space launch market see: The Future of the Commercial Space Launch Market 1993-2005. Prepared for the Department of Transportation Office of Commercial Space Transportation by Decision Science Consortium, Inc. and Berner, Lanphier, and Associates, Inc. May 1991. 35p; and U.S. Congressional Budget Office. Encouraging Private Investment in Space Activities, Feb. 1991. p. 30-32.

geostationary transfer orbit (GTO) or geostationary orbit (GEO)³⁷ between 1990 and 2000 will range from 12 to 20 satellites per year.³⁸ The U.S. commercial and foreign demand for small to large capacity ELV services to low Earth orbit (LEO) is expected to be eight to 12 flights per year over the next 10 years.³⁹ Demand for suborbital flights is expected to total 80 to 110 flights over the next decade, or between eight and 11 flights per year.⁴⁰ The market assessments do not include Soviet and Chinese plans for satellites which are not offered for commercial launches.

Commercial Payload Launch Requirements 1991-2000	
Launch Vehicle Type	Number per Year
Large Capacity to GTO/GEO	12-20
Small-Large Capacity to LEO	8-12
Suborbital Vehicles	8-11
Total	28-43

Prepared by CRS.

Sources: Space Services Inc., Martin Marietta Commercial Titan Systems, Euroconsult: World Space Industry Survey: Ten Year Outlook, 1989/90 Edition, and U.S. Department of Commerce.

Demand for commercial satellite launches is unpredictable. It is driven by the uncertain pace of developments in satellite technology and by the willingness of companies to bear major risks in bringing new services and applications to the market. The wider use of fiber optics for communication services might shrink the satellite market, but the advent of new satellite technologies or market applications could broaden it. New products are being

³⁷ Geostationary Orbit (GEO) is the orbit 35,800 kilometers above the equator. A satellite placed in GEO will maintain a fixed position relative to a position on the Earth. Geostationary transfer orbit (GTO) is an elliptical intermediate orbit between low Earth orbit (LEO) and GEO into which satellites are initially placed; either an upper stage or an engine is then used to boost the satellite to its final geostationary orbit.

³⁸ Data provided from Martin Marietta Commercial Titan Systems and Euroconsult: World Space Industry Survey: Ten Year Outlook, 1989/90 Edition.

³⁹ Information provided from Space Services, Inc., Apr. 1991.

⁴⁰ U.S. Dept. of Commerce. Commerce Department estimate based on market studies conducted by U.S. Launch Service Providers. Space Commerce and Industry Assessment, May 1988.

developed to bolster the satellite market, such as direct broadcast television, mobile communications, and private business networks. The ability to reduce launch costs could also potentially increase the size of the market. Yearly estimates of demand are also imperfect. Program scheduling and launch and payload delays affect accurate forecasting in the yearly prediction of launches. The size of the market will depend on how successfully satellite demand can counter high launch prices and technical inroads such as terrestrial fiber-optic communications.

It is easier to predict the large capacity market than the small capacity market as it takes at least 3 years to plan and develop large satellites. The small vehicle demand will remain largely speculative. Orbital Sciences Corp. predicts that there may be 330 separate small payloads ready for launch in the 1990s if they all were funded, but estimates that only 15-20 percent will actually be funded given current budget constraints.

Communications Satellites

The largest field of space applications that require launch services is communications satellites. Communications satellites to be launched into geostationary transfer orbits, en route to geostationary orbit, make up about 70 percent of the satellite market. Fifteen commercial communications satellites were orbited in 1988 by Western nations, 12 in 1989, and 16 in 1990. Commercial launch firms estimate that 66 to 101 communications satellites may be launched to orbit from 1991 to 1995 with 12-15 launched per year after 1995.⁴¹ The number of required launches will be less as some will be launched as dual payloads on one launch vehicle such as Arianespace's Ariane.

Commercial communications satellites may face a test of their growth potential in the next decade, as the mass market decides whether new services such as direct broadcast of television and mobile communications are viable. Demand is expected to peak about 1994, followed by a pattern of launches to replace old satellites once the market is saturated.⁴² The impending proliferation of new satellites has led several experts to predict a forthcoming glut of transponder⁴³ capacity by 1992.

Earth Observation and Scientific Satellites

The earth observation market is the second largest field of space applications requiring commercial launch services. This segment includes

⁴¹ Data provided from Martin Marietta Commercial Titan Systems and Euroconsult: World Space Industry Survey: Ten Year Outlook, 1989/90 Edition.

⁴² Survey finds U.S. to Maintain Dominance in Commercial Space Markets. *Aerospace Daily*, Jan. 5, 1990. p. 31.

⁴³ Receiver on a satellite that upon receiving a designated signal, amplifies the signal and transmits it to another satellite or a receiving station on the Earth.

meteorology and remote sensing satellites. Commercial launch firms estimate that seven to 18 meteorological and observation satellites will be required for launch in 1991-2000. Three to seven scientific payloads may also require launches from 1991 to the year 2000.

Earth observation has only recently entered the commercial market. The market represented by the supply side of this space segment is relatively closed. Programs are generally financed by Government agencies, and thus are carried out most often by the corresponding national companies for launching. The market is relatively limited and at the worldwide level represents an average of one satellite per year for the upcoming decade for civilian meteorology, and one to two satellites a year for civilian remote sensing applications.⁴⁴ The number of remote sensing payloads depends upon whether a few large satellites with many sensors are used versus many small satellites with a few sensors. In addition, if lower-cost sensors are developed, remote sensing satellites may become more affordable for private operators.

Microgravity Experiments

After communications and earth observation, the use of the microgravity environment for materials processing and microgravity experiments comprises the third major area of space applications requiring commercial launch services. Microgravity experiments are at a much earlier stage of development. As it appears in the short and medium term, the market is one of testing, and its customers are finding it difficult to finance the high cost of in-orbit experimentation. This has led to an increase of interest in sounding rockets to perform suborbital flights that offer 5 to 18 minutes of microgravity environment.⁴⁵

The demand for suborbital flights is expected to be 80 to 110 flights from 1991 to 2000, or between eight and 11 flights per year.⁴⁶ Demand for suborbital flights could increase beyond these projections, particularly in the areas of materials processing, biological sciences, and atmospheric physics. For instance, sounding rockets could be used to relieve a portion of the secondary payload backlog on the shuttle. Roughly 20 percent (40-130) of the Get Away Special (GAS) payloads currently on the shuttle's secondary manifest could be

⁴⁴ Euroconsult: World Space Industry Survey: Ten Year Outlook, 1989/90 Edition.

⁴⁵ Ibid.

⁴⁶ According to an Orbital Sciences Corp. Space Data Div. spokesperson, April 1991.

flown on suborbital rockets.⁴⁷ In addition, increased reliability of sounding rockets and lower cost flight opportunities could increase the demand.

Commercial Payload Launch Requirements 1991-2000	
Payload Type	Number per Year
Communication	19-29
Earth Observation	1-2
Scientific	0-1
Microgravity	8-11
Total	28-43

Prepared by CRS.

Sources: Space Services Inc., Martin Marietta Commercial Titan Systems, Euroconsult: World Space Industry Survey: Ten Year Outlook, 1989/90 Edition, and U.S. Department of Commerce

U.S. GOVERNMENT PAYLOADS

The U.S. Government is the single largest buyer of launch services in the West, and it is likely to remain so for some time to come. The Government requires launch services for a wide variety of military and civilian missions. Basically, the Government can either procure a launch vehicle and launch it using Government personnel, or it can purchase the services on a commercial basis, as non-government buyers do. As already discussed, the choice between these alternatives (the degree of Federal involvement in the launch operation) is one of the most important influences the Government has over the U.S. commercial launch industry.

U.S. Government demand is composed of two sectors: national security and civil Government. National security demand results mainly from the Department of Defense and intelligence community requirements to launch satellites that provide communications, reconnaissance, weather forecasting, and navigation aids. Civil Government demand arises from requirements by NASA

⁴⁷ U.S. National Aeronautics and Space Administration. Commercial User Compendium Document, Task 4, Final Report of the Alternate Commercial MPS Program to Supplement Shuttle Capacity. According to the report, approximately 20 percent of the payloads on the shuttle secondary manifest can get the data they need in five minutes or less of microgravity time. This is well within the microgravity time provided by most types of sounding rockets. Dec. 15, 1987. p. 61.

to launch scientific and experimental payloads, as well as requirements by other governmental agencies to launch payloads such as the weather satellites operated by the National Oceanic and Atmospheric Administration (NOAA) of the Department of Commerce.

Department of Defense

The total Department of Defense demand between 1991 and the year 2000 is estimated to be approximately 119 "shuttle equivalent flights," or 10 shuttle flights per year.⁴⁸ The demand for large capacity launches to GTO or GEO is expected to range from 8 to 14 from 1991 to the year 2000.⁴⁹ Since the *Challenger* accident, DOD has removed the majority of its payload requirements from the shuttle manifest, and developed a plan to fly them on ELVs instead.

The demand for small to large capacity ELV services to LEO is estimated to be at least 10 launches per year to 1995 and up to 15 per year from 1995 to 2000.⁵⁰ Several programs are in the study phase that could increase this projection. The Defense Advanced Research Products Agency's (DARPA's) lightsat proposal concerns a multi-satellite communications system which would consist of many small satellites used to form a secure command, control and communications network. DOD is also looking at programs that would increase its requirements for polar orbit⁵¹ missions for research and observation satellites.

There are a number of different programs within DOD that have a continuous demand for suborbital flights for research and test payloads. These include programs run by the Air Force Geophysics Laboratory, the Air Force Ballistic Missile Office, the Strategic Defense Initiative Organization, the Army Target Office, and the Naval Research Laboratory. All combined, their requirements for suborbital launch services could total 250 to 300 launches between 1991 and the year 2000, or 25 to 30 per year.⁵²

⁴⁸ National Space Launch Program report to Congress, Mar. 14, 1989.

⁴⁹ The DOT estimates that only two DOD medium or large capacity launches per year will use fully fledged commercial launch services in the next decade.

⁵⁰ According to Air Force officials, Aug. 1990.

⁵¹ A polar orbit is one that passes over or near the Earth's poles at inclinations of around 90 degrees (North-South direction) with the equator.

⁵² Information provided by Air Force Space Division.

Department of Defense ELV Requirements 1991-2000	
Launch Vehicle Type	Number per Year
Large Capacity to GTO/GEO	8-14
Small to Large Capacity to LEO	10-15
Suborbital	25-30
Total	43-59

Prepared by CRS.

Source: Department of Defense--U.S. Air Force.

National Aeronautics and Space Administration

NASA's August 1991 Mixed Fleet Manifest lists 32 civilian sector payloads to be flown on ELVs from December 1991 to August 1997. Preliminary NASA studies on ELV demand indicate that medium to large capacity launch service requirements from 1991 to the year 2000 should be three to five per year.⁵³ In sum, NASA's demand for medium to large capacity ELVs between 1991 and the year 2000 totals 30 to 50 launches.

For small capacity launch services, NASA deploys a wide range of payloads for research and experiments in such areas as physics, biology, materials, astronomy, weather observation, and navigation. NASA's official manifest lists eight launch requirements through 1997 for small capacity services.⁵⁴ NASA internal studies estimate launch service requirements in the small capacity category at one to three payloads per year between the years 1991 and 2000. In addition, a number of experiments that were scheduled on the shuttle secondary payload manifest have been put on hold or delayed. Many of these could be placed into LEO by small capacity ELVs and returned to earth via reentry capsules (COMET) now in the planning stages.

NASA has its own requirements for suborbital flights for research and testing in a wide range of areas. All combined, civil Government requirements are expected to total 400 to 700 launches by the year 2000, or 40 to 70 flights per year.⁵⁵ These numbers are supported by NASA's internal plans, which call for approximately 60 suborbital flights per year. They are also supported by

⁵³ Information provided by NASA.

⁵⁴ The assignments consist of six approved flights and eleven requested flights.

⁵⁵ Information provided by NASA's Office of Space Science and Applications.

historical data on NASA's sounding rocket activities. Between 1962 and 1975, NASA launched an average of 126 suborbital flights per year. Even between 1976 and 1985, when many of the sounding rocket payloads were placed on the shuttle secondary payload manifest, the lowest number of suborbital rockets launched by NASA in any year was 35.⁶⁶ As discussed earlier, NASA's Centers for the Commercial Development of Space (CCDS) are developing an estimated 70 experiments that will require suborbital launches between 1991 and 1995.

National Aeronautics and Space Administration ELV Requirements 1990-2000	
Launch Vehicle Type	Number per Year
Medium to Large Capacity	3-5
Small Capacity	1-3
Suborbital	40-70
Total	44-78

Prepared by CRS.

Source: National Aeronautics and Space Administration.

National Oceanic and Atmospheric Administration

The Commerce Department's National Oceanic and Atmospheric Administration (NOAA) handles the procurement for the launching of its Geostationary Operational Environmental Satellites (GOES) through NASA. In the past, NOAA went to NASA, which purchased the necessary vehicles, then managed the launch. Now NASA procures launch services for GOES, with the commercial launch firm managing the launch. In 1988 a contract was signed with General Dynamics to launch the GOES I, J, and K spacecraft on Atlas I ELVs, with options to launch the GOES L and M spacecraft as well. Additional NOAA launch requirements through the year 2000 consist of the launch of the Landsat 6 land remote sensing satellite in mid-1992, possible launch of Landsat 7, and six polar orbit launches of NOAA weather satellites for which Atlas E and Titan II ELVs are already committed.⁶⁷

⁶⁶ NASA Catalog of Sub-Orbital Launches by Year, 1990.

⁶⁷ Information provided by the National Environmental Satellite Data and Information Service, National Oceanic and Atmospheric Administration, July 1991.

CHAPTER 5

U.S. LAUNCH SERVICE PROVIDERS

Expendable launch vehicle services are offered by several firms in the United States, Europe, The Peoples Republic of China, and the Soviet Union. In the U.S., large capacity ELV services are currently offered by McDonnell Douglas Astronautics Company, General Dynamics Space Systems Division, and Martin Marietta Commercial Titan Systems. Small capacity ELV services are offered by Orbital Sciences Corporation, LTV Corporation, EER Systems Corporation (Space Services Division) and other small firms. Martin Marietta, McDonnell Douglas, General Dynamics, and LTV Corporation have each obtained a license to market commercially the vehicles it developed and manufactured under Government contract.

The major sector of the commercial launch market is geostationary communications satellites. Most of the activities of Europe's Arianespace, General Dynamics, Martin Marietta, and McDonnell Douglas are directed toward launches of this type of satellites. The launch vehicles these companies offer also have LEO launch potential, and some commercial contracts are for such launches and will continue to be so. Arianespace and other foreign launch providers are discussed in the next Chapter.

UNITED STATES

Large Capacity ELV Providers

McDonnell Douglas. McDonnell Douglas' Delta is the least powerful U.S. commercial ELV being marketed for geostationary transfer orbit (GTO) launches. The Delta launch vehicle is based on the Thor intermediate-range ballistic missile (ICBM) and first flew in 1960. As NASA's medium-class workhorse, Delta underwent several upgrades since 1964. McDonnell Douglas now offers the Interim Delta II 6920/25, which can place 1,448 kilograms (kg) in GTO. This is an enhanced Delta 3925 version (no longer used), with a longer first stage oxidizer tank, uprated solid rocket motors, and extended second stage. The fully-fledged Delta II 7925, with an improved first stage engine and uprated solid rocket boosters increases this GTO capacity to 1,818 kg. Both of these vehicles are currently available. These vehicles were initially produced under

a Government contract as the Medium Launch Vehicle (MLV) to launch the Navstar GPS navigation satellites. Both vehicles can be used for satellite launches into low Earth orbits. The LEO capability of an interim Delta II 6920/25 is 3,970 kg and for the Delta II 7925, 5,000 kg.

By September 1, 1991, 206 Delta launches have been recorded (with 12 failures) from Pad SLC-2W at Vandenberg and from Launch Complex 17's Pads A and B at Cape Canaveral. The last launch failure occurred in May 1986, since then there have been 28 straight successes. Of these, 15 were by the Interim Delta II 6920/25 and five by the Delta II 7925. The final non-Delta II class booster (Delta 3925) carried India's Insat-1D into orbit on June 12, 1990.

The Commercial Space Launch Act of 1984 encouraged McDonnell Douglas to enter the commercial launcher market, through a company called Transpace Carriers. The Arianespace-Space Shuttle commercial duopoly gave the Delta little chance. After the withdrawal of the Shuttle from the commercial launcher market in 1986, McDonnell Douglas began marketing the Delta itself. Production costs were underwritten by a \$669 million contract from the Air Force for the MLV program. McDonnell Douglas' first commercial launch took place on August 27, 1989, carrying BSB's Marcopolo-1 into GTO. The first flight of a fully fledged Delta II 7925 placed a Navstar GPS satellite into orbit on January 1, 1990. Eleven Delta launches took place in 1990 (including five commercial). Ten launches were planned for 1991, and as of September 1991, five had taken place (four were commercial).

Including the MLV contract, McDonnell Douglas has received 39 launch commitments. Those already launched are: 11 DOD GPS satellites under the MLV contract, three Strategic Defense Initiative Organization (SDIO) payloads, COBE and ROSAT for NASA, Marcopolo 1 and 2, two Inmarsat 2s (F1 and F2), NATO IVA, Palapa B2R, Contel ASC-2, and AURORA II. Launches to be made are: eight GPS satellites, Satcom C-3, Palapa B4, and EUVE, Geotail, Wind, and Polar for NASA, whose contract with McDonnell Douglas includes options for two science satellite launches through 1997. The company believes it has the capability to launch a total of 12 satellites a year using two launch pads, 17A and 17B, at Cape Canaveral. Pads 17A and 17B have been modified to accommodate the taller Delta IIs. Pad SLC-2W at Vandenberg is also being modified to launch the Delta II.

McDonnell Douglas has released details of a possible but as-yet uncommitted upgrade to the Delta vehicle. The upgrade to a Delta III 7930/35 version would include a cryogenic Pratt and Whitney Centaur second stage, a larger payload fairing, and an enlarged first-stage fuel tank. Wide body and double-barreled versions with two first stage engines strapped together would also be possible. Such versions would increase Delta's GTO capacity to between 2,600 kg and 3,600 kg. The double-barreled versions would compete with General Dynamics' Atlas.

General Dynamics. The Atlas ICBM was successfully tested in December 1957, after one earlier failure. As well as having an operational role from 1959 to 1965, it was used as an Air Force and NASA launch vehicle on its own and

with upper stages, including Agena and Centaur. Gradually uprated during its service, 499 Atlases had been launched by September 1991. Only six of the older version Atlas E launch vehicles remain. Two Atlas Es will be used to launch NOAA polar weather satellites and the others are available for DOD launches, none of which is committed. Launches of the Atlas E are made from pads SLC-3E and SLC-3W at Vandenberg. The latest version is the Atlas I, originally known as the Atlas Centaur. The Atlas I can place 2,240 kg into GTO and has been fitted with a new fairing, laser guidance, and a new data acquisition system.

Like the other major ELV companies in the U.S., General Dynamics attempts to enter the commercial market in the mid-1980s were unsuccessful. After the *Challenger* accident in 1986 and the company's failure to win the Air Force's MLV contract, General Dynamics made a \$100 million investment the following year to produce 18 new Atlas Centaur vehicles known as the Atlas I for the commercial market. The Atlas-Centaur combination first flew on May 8, 1962, from Cape Canaveral (this launch was a failure). There have been 70 Atlas-Centaur/Atlas I flights and 58 have been successful. As of September 1991, General Dynamics has conducted two commercial launches, both using the Atlas I. Their first commercial launch was NASA's CRRES payload on July 25, 1990 from Cape Canaveral. Their second commercial launch was April 18, 1991, for Japan's Broadcasting Corporation's BS-3H satellite. This launch ended in failure when one of the two engines in the second stage failed to ignite. An independent review board concluded that foreign object damage (FOD) most likely caused an engine to fail.⁵⁸

General Dynamics secured a \$440 million Air Force contract in 1988 for its MLV-2 program. The contract is to produce 11 vehicles to launch the DSCS III communications satellites. The MLV-2 vehicle became known as the Atlas II and incorporates an upgraded first stage. General Dynamics is able to offer this vehicle commercially, in addition to MLV-2 upgrades called the Atlas IIA and Atlas IIAS. The Atlas II is planned to make its debut late in 1991 and is designed to place 2,750 kg into GTO. The Atlas IIA is planned to fly in 1992, while the Atlas IIAS is scheduled to make its first flight in 1993, carrying up to 3,500 kg to GTO. This is accomplished by the addition of four Castor IV solid propellant strap-on boosters.⁵⁹ Further upgrades are being considered, including increasing the number of solid strap-ons.

As a result of confidence gained from its Government commitments and its early commercial contract commitments, the company is planning to produce 60 Atlases by 1997 to reduce the overall costs of its launch services. The multiple-

⁵⁸ FOD Considered Most Likely Cause of Atlas/Centaur Failure. *Aerospace Daily*, June 28, 1991. p. 530.

⁵⁹ The International Telecommunications Satellite Organization (Intelsat) is paying \$9.5 million for hardware and software changes to the Atlas IIAS to increase its payload capacity for launching Intelsat 7 satellites. The ability to launch heavier payloads is intended to extend the operational lifetimes of the Intelsat 7 satellites because it increases each satellite's fuel capacity.

buy reduces the cost of an individual Atlas and showed the company's commitment to the commercial launch industry. Of the 60 Atlas vehicles, 13 are Atlas Is. Through 1997, 36 Atlas launches are committed (21 are considered commercial); the formal contract for two of these has still to be confirmed. General Dynamics' future payloads include: one Eutelsat, three GOES-NEXT, two Galaxy, 11 DSCS IIIs, Intelsat K, ten U.S. Navy UHF-Follow On satellites (considered commercial launches), SAX, two Intelsat VIIs, NASA's SOHO, two Orion satellites, and two Telstar IV satellites. Options remain for further GOES-NEXT, Eutelsat, and Intelsat VII launches.

The company says it can launch 12 vehicles a year by 1993, using two launch pads, 36A and 36B, at Cape Canaveral.⁶⁰ Four launches from each pad in 1992 are possible. A \$30 million refurbishment of pad 36A was completed in April 1991 so it could accommodate the Atlas II vehicle. Pad 36B will be considered the commercial pad, while 36A will be used for military as well as for commercial customer launches. The U.S. Air Force is also planning to refurbish the SLC 3-E pad at Vandenberg to allow for Atlas II polar launches beginning in 1995.⁶¹

General Dynamics believes that the commercial sector market will peak at 20 launches per year in the mid 1990s, and estimates that the company will perform three commercial launches per year realistically, with about three additional commercial military and Government launches per year. Despite its apparent success, in January 1991, General Dynamics took a \$300 million write-off on its commercial Atlas launch program.⁶² In February 1991, the firm also announced a management shake-up in its Space Systems Division. Despite the management shake-ups and financial losses, General Dynamics has stated that they remain committed to the commercial launch business.⁶³ The Atlas I launch failure in April 1991, however, may make it more difficult for General Dynamics to receive future launch contracts.

Martin Marietta. Martin Marietta Space Launch Systems provides Titan II and Titan IV launch vehicles for Air Force requirements and the Commercial Titan for commercial launches. The first Titan II ICBM was test-flown on March 16, 1962. A further 80 launches followed until the fleet was deactivated in 1982, by which time 140 ICBMs had been built. Twelve Titan II vehicles also carried Gemini spacecraft into orbit, ten of them with astronauts, between 1964 and 1966. The Titan II also provided the first two stages of a family of Titan

⁶⁰ Only one is currently operational.

⁶¹ Isbell, Douglas. Pad Reactivation to Serve Secret Satellite Needs. *Space News*, July 29-August 4, 1991. p. 1.

⁶² A write-off is an accounting procedure that cancels the value of assets as a financial loss.

⁶³ Boyer, William. General Dynamics Stands Firm on Launch Business. *Space News*, Mar. 25-31, 1991. p. 8.

multi-stage launchers, from the Titan IIIA to the latest member of the fleet, the Titan IV.

In 1987, the final Titan II was removed from its silo as Martin Marietta was working on a \$483 million Air Force contract to refurbish up to 15 of 56 deactivated Titan IIs as launch vehicles. The first refurbished Titan II flew in 1988 from pad SLC-4W at Vandenberg. Further launches of the remaining fleet of 15 are planned to continue through 1995, when further refurbishing of ICBMs may occur. There are no plans to commercialize the Titan II, although it will be used to launch NOAA weather satellites and Landsat 6 for EOSAT in mid-1992.

In 1984, the Air Force, mindful of the Shuttle's inability to satisfy all its needs, ordered ten Complementary Expendable Launch Vehicles (CELVs) from Martin Marietta. Called the Titan IV, this is an uprated version of the Titan 34D which was still flying at the time. The order has been progressively increased and now stands at 41, with an option for eight more. Four Titan IVs have already been launched, the first on June 24, 1989. Titan IV is designed to carry shuttle-class payloads, such as reconnaissance satellites, electronic-intelligence satellites, and DOD communications satellites. Launches of the Titan IV are from Cape Canaveral's Pads 41A and 41B and Vandenberg's Pad SLC-4E.

After the 1986 *Challenger* accident, Martin Marietta announced that its Titan 34D version would be available for commercial launches beginning in 1989, and known as the Commercial Titan. The Titan 34D, introduced in 1982, was the latest in a series of thrust-augmented Titan II boosters, starting with the Titan IIIC in 1965. The Titan 34D flew 15 times with two failures through September 4, 1989. Together with the three Commercial Titan launches so far, there have been 144 launches of the Titan III-class booster, with 137 successes. The major difference between the Commercial Titan and the 34D is a new-style payload fairing supplied by Contraves. The Commercial Titan can take a maximum of 14,800 kg to LEO. GTO capability ranges from 1,270 kg per satellite on a dual launch, to 5,400 kg on a single launch (using a Transfer Orbital Stage (TOS)).

Initial marketing of the vehicle placed emphasis on its versatility as a single or dual-launch vehicle with a range of upper stages. The company received five commercial launch contracts. Britain's Skynet 4A and Japan's JC Sat 2 were launched together on the first and only dual-satellite Commercial Titan on December 31, 1989. After this launch, Martin Marietta decided to only market single-satellite launches in the future. The second commercial launch, of and Intelsat VI in March 1990, failed, but another Intelsat VI was launched successfully in June 1990. The fifth contract is from NASA to launch the Mars Observer in 1992. This launch is not considered a commercial launch and will not require a commercial license from OCST.

Martin Marietta claims it is still active in the commercial market, despite reports in the media that it is withdrawing. Its goal is to launch one to two Commercial Titans a year despite the fact that the number of satellites of the

size requiring Titan launches is shrinking.⁶⁴ In July 1991, it was announced that Martin Marietta was considering offering a new Titan configuration, called Titan 3L, which would be targeted for commercial single satellite launches.⁶⁵ The Titan 3L would employ two liquid propellant strap-on boosters instead of the two solid boosters used on the current commercial Titan. This launcher would be capable of carrying 9,100 kg payloads into LEO.⁶⁶

Small Capacity ELV Providers

Orbital Sciences Corporation/Space Data Division. In April 1987, Orbital Sciences Corporation (OSC) joined forces with Hercules Aerospace in a \$60 million venture to develop the Pegasus air-launched satellite launcher. Within three years, OSC had a successful first launch of Pegasus on April 5, 1990. The second Pegasus launch, July 17, 1991, put seven small satellites into a lower orbit than was intended. The lower orbit was caused when the first stage failed to separate properly from the rocket after completing its burn. Pegasus is based on solid-propellant motors used for the Trident and Pershing missiles and was developed with the help of a DARPA contract to launch small research and development satellites. Up to six launches were covered in the contract at a cost of \$6.5 million per launch. Two of these launches have been subcontracted to the Air Force. Pegasus launches are made from NASA's B-52 aircraft over the Pacific Ocean after take-off from Edwards Air Force Base in California. It can carry between 270 kg and 400 kg into LEO.

In March 1991, OSC received a contract from NASA for seven Pegasus launches with options for three additional launches as part of its Small Expendable Launch Vehicle (SELV) program. In April 1991, the Air Force contracted with OSC for one Pegasus launch with options for 39 additional launches as part of the Air Force Small Launch Vehicle (AFSLV) program. Ball Aerospace has made two launch reservations for small communications satellites and Sweden has also made a reservation for the potential launch of the Freja satellite (although the primary launch contract is with China-see Chapter 6).

An uprated Pegasus has been proposed, while a ground-launched vehicle called Taurus, based on the MX missile stage, is being developed under a Small Satellite Launch Vehicle (SSLV) contract from DARPA. The first launch of Taurus is scheduled in 1992. Plans are to launch Taurus from both Cape Canaveral and Vandenberg and possibly from NASA's Wallops Island in Virginia. The Taurus could be offered for commercial launches.

Space Data, a division of OSC, commercially offers sounding rocket launches on its Aries, Prospector, and Talos Castor-1 sounding rockets. In 1989,

⁶⁴ Marcus, Daniel J. Future Clouded for Commercial Titan. *Space News*, Mar. 26-Apr. 1, 1990. p. 29.

⁶⁵ Marcus, Daniel J. Martin Marietta Ponders Reviving Commercial Titan. *Space News*, July 15-28, 1991. p. 1.

⁶⁶ *Ibid.*

Space Data won a contract from NASA's Commercial Center for the Development of Space (CCDS) in Huntsville, Alabama, for four Joust microgravity payloads to be launched from Cape Canaveral. The first Joust launch ended in failure June 18, 1991. The Prospector sounding rocket had to be destroyed 25 seconds after launch when the rocket veered off course. The second Joust launch has been rescheduled for May 1992. Space Data has a contract from the Strategic Defense Initiative Organization (SDIO) for 20 launches of its Aries sounding rocket from White Sands, NM as part of its Lightweight Exoatmospheric Projectile (LEAP) program. The LEAP launches are licensed commercially with the LEAP-1 launch scheduled in October 1991. Space Data has a second contract with SDIO for its ZEST program using Talos Castor-1 sounding rockets. ZEST-1 had a successful launch September 3, 1991 from the Pacific Missile Range Facility at Kauai, Hawaii. ZEST-2 was successfully launched on September 12, 1991. Both of these launches were licensed commercially. SDIO also has a contract with Space Data for Aries launches at part of its Red Tigress program. The first Red Tigress launch from White Sands ended in failure on August 20, 1991, when a technician gave incorrect guidance information to the sounding rocket. This was not a commercially licensed launch.

LTV Corporation. In 1958, NASA awarded Chance Vought (later LTV) a contract to develop a four-stage solid-propellant satellite launcher capable of placing about 60 kg into LEO. This vehicle, the Scout, made its first flight on July 1, 1960. Sixteen versions of the booster were developed and flew 100 mission to June 1979, with 14 failures. The current Scout version, the G-1, was first launched on October 30, 1979. Launches are made from Pad SLC-5 at Vandenberg, Launch Area 3 at Wallops Island, and the Italian San Marco offshore platform in Formosa Bay, Kenya. The Scout vehicle is now being offered as a commercial launcher, but no contracts have been made for launches. The standard Scout launch vehicle is a solid propellant, four stage booster system, which provides efficient launch for small spacecraft. The Scout is capable of orbital and suborbital missions and can place a maximum of 220 kg into LEO.

LTV has joined with the Italian company SNIA-BPD to develop the Scout II, also called San Marco, for commercial operations. Launches will be primarily from the San Marco offshore platform, and the vehicle may be able to carry 500 kg into LEO.

EER Systems (Space Services Division). One of the first privately funded U.S. small satellite launcher companies, Space Services, Inc. was established in 1980. The company offers its Conestoga launch vehicle for orbital launches. The Conestoga has undergone several redesigns over the past ten years. The first vehicle was to have been liquid-fueled, and its Percheron first stage made a maiden flight off the Texas coast on August 12, 1981, but exploded. An all-solid propellant Conestoga was then designed; its proposed first stage, based on a Minuteman 1 second-stage motor and called Conestoga 1, was launched successfully on a suborbital flight on September 9, 1982. Conestoga versions 2 to 5 would have been combinations of Castor solid propellant motors, capable of placing between 190 kg to as much as 2000 kg in LEO. Space

Services signed an agreement with NASA in 1986 to launch from NASA's Wallops Island facility. Several tenuous launch agreements were made, but no orbital launches occurred of the Conestoga.

In the late 1980s, the company began concentrating its efforts on marketing its smaller Starfire sounding rocket for microgravity research missions. In 1988, the company won a contract from NASA's Commercial Center for the Development of Space (CCDS) at the University of Alabama at Huntsville for the suborbital launching of microgravity experiments. The first U.S. commercial launch successfully took place in 1989 from White Sands with the launch of the Consort-1 microgravity payload on a Starfire sounding rocket. The second launch of a Starfire failed on December 11, 1989, but on May 16, 1990, the third Starfire launch was launched successfully. A fourth Consort launch is expected in November 1991.

In late 1990, the company lost a substantial amount of its financial backing and laid off most of its employees. In December 1990, however, the company was taken over by EER Systems. Its fortune changed in February 1991, when EER/Space Services was awarded a contract by the CCDS at the University of Tennessee to launch the CCDS's Commercial Experiment Transporter (COMET) microgravity capsule with the Conestoga. The contract is estimated to be worth \$45 million and includes three flights and two options of the COMET. The first flight is scheduled in September 1992 from Wallops Island, VA. EER/Space Services intends to continue marketing Conestoga launch services in addition to the COMET program.

American Rocket Company (AMROC). In 1985 AMROC became one of the first U.S. private launcher firms to attempt to enter the commercial market. It proposed an industrial launch vehicle (ILV) capable of placing 1,250 kg into LEO. AMROC's innovation was to base the ILV on a single-module hybrid motor burning liquid oxygen and a hydrocarbon fuel and stacking 22 modules together in various combinations to form a four-stage satellite launcher. Agreement was reached with the Air Force to launch from Vandenberg. As other private companies found, funding and customers proved elusive, and the company's aim became more modest. A single-module launch vehicle (SMLV) was proposed for initial suborbital missions. The hybrid-motor was test-fired successfully over 100 times, but a setback occurred when the first SMLV caught fire on its Vandenberg launch pad in November 1989. The firm also considered the possibility of a water-launched vehicle for small payloads. As a result of the November 1989 failure and financing difficulties, AMROC decided to leave the launching business and concentrate on rocket engines. The exodus from the commercial launching market did not last long, as AMROC bid for the CCDS's COMET launch contract in October 1990 using a seven-module booster called Aurora. Despite not being awarded the contract, AMROC is proceeding with a design based on the ILV called Aquila that could provide launch services by late 1994.

E Prime Aerospace. E Prime is one of the several small companies that tried to enter the commercial satellite launch market in the 1980s. When E Prime could not find any customers, it lowered its sights to suborbital rockets.

The firm currently markets three Astra sounding rockets. The first Astra flew from Cape Canaveral in November 1988 carrying a SDIO payload, but no further launches have taken place. E Prime hopes to follow the Astra sounding rockets with a fleet of Astra B satellite launch vehicles based on the MX missile. No Astra B launches have taken place, nor have any launch contracts been signed.

Conatec. Conatec received the first DOT launch license on June 22, 1988, but has not conducted any commercial launches. The firm currently is concentrating on sounding rocket launches and has been performing sounding-rocket services for NASA the past four years with its C-130 launch vehicle.

CHAPTER 6

FOREIGN LAUNCH SERVICES PROVIDERS

EUROPE: ARIANE AND ARIANESPACE

Europe's Ariane launch vehicle is the primary competitor to U.S. systems. Developed by the European Space Agency (ESA), a group of 13 European countries⁶⁷ launches are now conducted by a private company, Arianespace, which is incorporated in France. ESA continues to have responsibility for developing new versions of the Ariane and is currently working on the Ariane 5. The only operational version of Ariane today is the Ariane 4 (previous versions have been phased out over time).



Europe's Launch Site and Vehicles

From 1979 through September 1, 1991, there were 40 successful Ariane launches, and 5 failures. Launches take place from Kourou, French Guiana, South America (5.2°N, 52°W). The proximity of the launch site to the equator

⁶⁷ Austria, Belgium, Denmark, France, Germany, Ireland, Italy, Netherlands, Norway, Spain, Sweden, Switzerland, and the United Kingdom. (Austria, Ireland and Norway did not participate in Ariane's original development.)

is an advantage to using Ariane since less fuel is needed to achieve geostationary orbit than for a satellite launched from latitudes further north or south (such as Cape Canaveral). Thus, heavier satellites can be launched, or the satellites can be equipped with more stationkeeping fuel which could prolong the spacecraft's life.

An Ariane failure in 1986 (shortly after a string of U.S. launch failures, including the space shuttle *Challenger*) grounded the system for 15 months. The most recent failure, on February 22, 1990, interrupted operations for 5 months. Two Japanese communications satellites (Superbird and BS-2X) were lost when the Ariane exploded shortly after liftoff. The satellites were insured for \$190 million. An investigation revealed that a handkerchief-sized cloth had been left in a water supply line to one of the first stage engines, causing the engine to lose pressure. The preliminary estimate of the cost of the failure is 200 million French francs (\$36 million). Changes to the launch vehicle's design because of the failure were handled by ESA through its Ariane Research and Technology Program, but operational or production costs incurred as a result of the accident were Arianespace's responsibility.⁶⁸

The Ariane 1, Ariane 2 and Ariane 3 have been phased out of service. The only version of Ariane now available is the Ariane 4, with a lift capability of 2,000-4,400 kg to geostationary transfer orbit (GTO). Arianespace does not reveal prices paid by customers (although customers may make them public), but according to press reports, prices for launches to GTO are approximately: \$25 million for the dual launch of satellites in the 700-800 kg range; \$50 million for 1200-1600 kg; \$60 million for 2,000-2,500 kg; \$70 million for 2,500-3,000 kg; and \$90 million for more than 3,000 kg.⁶⁹ In 1989, Arianespace placed an order for 50 Ariane 4 vehicles as a method of reducing costs. The bulk purchase was expected to enable a price decrease of 20 percent,⁷⁰ but at the end of 1990, an Arianespace representative complained that the drop in the value of the dollar had canceled out the importance of this decrease in terms of competition with American companies.⁷¹ Customers are required to pay 10-15 percent at the time the contract is signed, with quarterly installments of 10 percent and four payments of 5 percent in the last eight months before launch.⁷²

⁶⁸ Lenorovitz, Jeffrey. Europe Resumes Commercial Launch Services With Ariane. *Aviation Week and Space Technology*, July 30, 1990. p. 23.

⁶⁹ Chenard, Stephane. Selling Ariane. *Space Markets*, 3/1990 [May/June], p. 121.

⁷⁰ Defense Daily, Jan. 25, 1990; and Another source says the bulk purchase allowed a reduction in price from \$85 million to \$60 million. *Flight International*, June 3, 1989. p. 44.

⁷¹ Iserland, Klaus. Ten Years of Arianespace. *Space Policy*, Nov. 1990. p. 342.

⁷² Ibid.

Multiple smaller satellites also can be accommodated on Ariane using the ASAP (Ariane Structure for Auxiliary Payloads) system which can accommodate up to six satellites weighing a total of 200 kg. The price for using the ASAP system reportedly is \$600,000. In 1992, Arianespace is expected to introduce the new SDS (SPELDA Dedicated Satellite) system for satellites too large for the ASAP, but too small to be carried as main payloads. The SDS will be able to accommodate satellites weighing 400-800 kg for a price of approximately \$19.5 million for 400 kg, or \$26 million for 800 kg.⁷³

ESA is now developing the Ariane 5 which is expected to launch 5,800 kg to GTO; prices are not yet available, but ESA hopes to lower production costs by 10 percent over Ariane 4, allowing lower prices of as much as 40 percent. Ariane 5 will have twice the capability of Ariane 4, but Arianespace does not expect to charge twice the price because there is less equipment involved. For example, Ariane 5 will have only one large engine rather than 10 smaller engines, so for 100 launch vehicles, only 100 engines need to be built instead of 1,000.⁷⁴ Development of Ariane 5 is expected to cost \$5.1 billion, and is managed by the French space agency, CNES. The first test flight is planned for 1995, with commercial operations beginning in 1996.⁷⁵ All the ESA member states except Britain are contributing to the program. (A major purpose for Ariane 5 is launching Europe's Hermes spaceplane--now being developed for taking crews to and from space--and it is possible ESA will have to develop a different version of Ariane 5 to provide the safety, reliability, and lift capability needed for Hermes.)

Arianespace, Inc.

Arianespace, Inc. markets launch services and supervises the construction of Ariane launch vehicles, conducts launches of Ariane, and offers launch insurance through its S3R subsidiary. The French space agency CNES is a major shareholder in Arianespace (32 percent); the other shareholders are 51 European companies and banks. (See appendix 4.) Arianespace was founded in 1980 as a private company, despite partial government ownership, and has been responsible for commercial Ariane launches since 1984. In general, European governments pay for improvements to the Ariane vehicle (such as development of new versions), and the French government covers insurance claims above 400 million French francs (approximately \$70.3 million).

⁷³ de Selding, Peter. Arianespace brochure "New Opportunity for Satellite Manufacturers and Operators: The Ariane SDS Class Launch Service." Ariane Light Payload Service Set for 1992. Space News, Aug. 13-19, 1990. p. 4.

⁷⁴ Face to Face--with Charles Bigot. Aerospace America, Jan. 1991. p. 6.

⁷⁵ Macrae, Duncan. Ariane 5 Moves Toward Flight Debut. Aerospace World, Aug. 1991, pp. 77-79.

Arianespace is seen as the world leader in commercial launch services, with 50-55 percent of the available market.⁷⁶ In 1989, Arianespace had sales of 3.793 billion French francs, or approximately \$630 million, with a net profit of 135 million French francs (approximately \$22 million).⁷⁷ Following their most recent launch (August 1991), Arianespace had contracts to launch 34 satellites, worth \$2.4 billion.⁷⁸

Arianespace has been very successful in winning contracts for satellite launches and there is little reason to expect this will change. Even after its most recent launch failure (February 1990) and before the cause of the failure had been determined, customers were signing orders with the company.

Arianespace's Klaus Iserland promotes the view that customer loyalty is an underpinning of his company's success. Noting that following a string of U.S. launch vehicles failures in 1986 (the space shuttle, Titan, and Delta all failed in the spring of 1986, and the only other major U.S. launch vehicle--Atlas--was also grounded because of design similarities with Delta), Ariane was the only Western launch vehicle available for commercial customers, he concludes that "Such services in difficult times are not quickly forgotten by hard-pressed customers"⁷⁹ (It should be noted that Ariane failed during the same period of time and its operations were interrupted for 15 months.) Another reason for Arianespace's success has been offered by the company's Chairman and Chief Executive Office, Charles Bigot. He argues that U.S. launch services companies rely on U.S. Government "favor," resulting in commercial payloads being "bumped" by U.S. Government satellites. "You should know that clients who have gone astray, who have made the error of using American launchers, having bitterly regretted it on occasion, and I mean very bitterly. Ask the British Ministry of Defense. Ask Intelsat, and maybe others . . . and they come very close to saying 'Never again.'" Bigot softened his statement by adding "Not all of them of course."⁸⁰

U.S./European "Rules of the Road" Negotiations

The extent to which Arianespace is or is not subsidized by the French government (or other European governments) has been a matter of contention since the company assumed operations of Ariane. There are no specific

⁷⁶ Ibid.

⁷⁷ 1989 Arianespace Annual Report.

⁷⁸ Arianespace's Biggest Booster Launches Intelsat 6 Satellite. *Aviation Week & Space Technology*, Aug. 19, 1991, p. 24

⁷⁹ Iserland, Klaus. Ten Years of Arianespace. *Space Policy*, Nov. 1990. p. 342.

⁸⁰ Quoted in: de Selding, Peter. Bigot: Federal "Pampering" Hinders American Launch Firms in Landing Commercial Business. *Space News*, Dec. 17-23, 1990. p. 3.

international guidelines that govern launch competition. It is generally guided by implicit guidelines known as "rules of the road" based on free and fair trading practices. Up to the present, the considerable government involvement in developing launch vehicles and associated infrastructure in all countries with space launch capabilities has meant that the relationship between customer launch charges and real costs is not easy to establish. For example, most civilian rockets were derived from military missiles and a considerable proportion of the expenditures in building the prototype and developing early models was covered by defense budgets.

In general, launch prices are based on an estimation of a cluster of basic factors such as the period of time necessary to write off the initial investment, the projected number of flights during this period which depends on demand expectations and the projected cost and desired rate of return on the investment. However, in the space business, not all fixed costs are recouped due to the specific nature of this activity and the involvement of governments in the establishment of space capabilities. For example, since the U.S. space shuttle is considered a national resource which is maintained for public purposes, R&D spending and in general non-recurring costs were not included in the cost base for the pricing of the shuttle launching service in the early 1980s when the shuttle services were being offered commercially.⁸¹

It is generally acknowledged that most launch services are subsidized either directly or indirectly. This affects the pricing of services in the short- and long-term. Pricing policies are affected by the amount of subsidization that has occurred in past development and the amount of current subsidies that may allow the launch firm to offer its services at a lower price. Future price competitions will be dependent upon the amount of subsidization that takes place. Without future subsidizations, costs (and hence prices) per flight may decrease if progress is made in increasing launch efficiencies. Growth in satellite demand would also increase launch demand and could reduce the price per launch. Alternatively, prices may increase if subsidies are phased out because companies may have to make up the difference with higher prices. Competition between the world's launching firms may depend highly upon countries' subsidization policies. It may be difficult to develop agreements that would create a level playing field.

Transpace Carrier Unfair Pricing Allegations. The issue concerning subsidized pricing of commercial launches was formally raised in 1984 by Transpace Carriers, Inc., a U.S. company then attempting to market launch services on the Delta ELV.

In 1984, Transpace initiated a complaint against Arianespace with the Office of the U.S. Trade Representative (USTR) for unfair trade practices under Section 301 (a) of the Trade Act of 1974. The petition was filed on behalf of the civil expendable launch services industry. The complaint alleged that the member countries of ESA, particularly France, were subsidizing the activities of

⁸¹ Organization for Economic Co-operation and Development. *The Space Industry, Trade Related Issues*. Paris, OECD, 1985.

Arianespace which was in direct competition with Transpace in selling launch services. The specific subsidy practices that Transpace complained about included:⁸²

- The two tiered pricing of launch services offered by Arianespace, where Member states of ESA agreed to pay 25 percent to 33 percent per launch more than is charged to the export market for the same services;
- The provision of launch and range facilities and services and/or personnel at no charge, or unreasonably low cost, to Arianespace by the French national space agency, CNES (the cost of launch and range facilities as services represents approximately one-third of the total cost of a launch);
- The provision of CNES administrative, management and/or technical personnel to Arianespace either at no charge or at rates that are unreasonably low; and
- The subsidization of mission insurance rates which Arianespace customers would otherwise pay.

Transpace stated that as a result of these subsidies, Arianespace had been able to offer launch services to U.S. companies and third country customers at rates which were substantially less than those charged to member states of ESA and substantially below those prices that Arianespace would be able to charge in the absence of subsidization. Transpace concluded that such subsidies posed a serious threat to the establishment of a U.S. commercial launch services industry.

USTR investigated, but ultimately dismissed the complaint because the European government backing of Arianespace was found to be no greater than U.S. Government backing of the commercial launches on the U.S. space shuttle. (As discussed elsewhere in this report, commercial launches are no longer offered on the space shuttle unless the cargo requires the unique capabilities of the shuttle or overriding foreign policy concerns exist.)

U.S./European Negotiations. The Transpace Carriers case raised the question of what "rules of the road" to follow in pricing launch services. Both sides agreed to discussions, but little progress was made in the late 1980s. In 1988 and 1989 when the U.S. was negotiating with China over its entry into the launch services market (see below), some Europeans expressed displeasure that the U.S. Government was moving ahead more quickly with China than with them. The Bush Administration's commercial space launch policy released in September 1990 stated that the U.S. Government would enter into negotiations

⁸² Petition Seeking Presidential Action Under Section 301 of the Trade Act of 1974, as amended (19 U.S.C. 2411, et seq.). Filed on behalf of the Civil Expendable Launch Services Industry by Transpace Carriers, Inc. p. 2.

to achieve an agreement with ESA, ESA member states, and others as appropriate, which defines principles of free and fair trade. On September 24, 1990, talks commenced between the USTR and ESA on establishing such rules of the road and looking at how the United States and Europe should respond to the entry of countries with non-market economies (NMEs, specifically the Soviet Union and China) into the launch services business.

The first actual negotiating session was held on February 26-27, 1991, where the two groups offered "framework" documents setting out their respective positions. Two working groups were then created to try to meld the position papers. The working groups do not have the authority to negotiate; they are simply developing documents that set forth both positions and indicate areas of agreement and disagreement. The first is dealing with "common principles" on pricing; the second deals with the NME issue. The working groups have met regularly since February. The Departments of Commerce, Defense, State and Transportation and USTR are represented on the first working group; all but DOD are on the second. The individuals representing DOC, DOS, DOT and USTR are the same for both groups.

A negotiating session was scheduled for April 29-30, 1991, but the decision was made to have the working groups meet again at that time instead. Another negotiating session was planned for July 10-12, 1991, but it also was postponed until the fall. The working groups continue to meet. Both sides anticipate that negotiations will continue through 1991. The U.S. expects that the final agreement would be signed not only by ESA, but by individual member countries of ESA that are involved in the Ariane launch vehicle and/or have satellites.

Scope of Discussions. A fundamental issue between the two sides is the scope of the agreement to be negotiated. According to USTR, ESA wants to limit the discussion to issues involving government support for launch service providers, such as research and development funding, use of launch facilities, insurance, etc., while the U.S. wants to broaden the scope to include "market behavior/trade" issues such as government "inducements" to customers (such as a European government offering rocket engine technology to a customer if the customer chooses an Ariane launch⁸³), as well as unfair business practices (such as bribes). The U.S. also wants a general statement on the principles of pricing. ESA's chief negotiator and director of administration, George van Reeth, asserts that ESA does not have the power to negotiate a comprehensive

⁸³ The French government reportedly offered Viking engine technology to Brazil if that country selected Ariane for launching Brazilian satellites. Such an agreement would have been in violation of the Missile Technology Control Regime (MTCR), adopted by the United States, France and other countries, which calls for restraint on exports of missile technology that could help countries acquire military missile systems. After complaints by the U.S. Government, France reportedly withdrew the offer because of the MTCR provisions.

trade agreement and the U.S. is complicating the talks by insisting on its position.⁸⁴

European Access to the U.S. Government Satellite Market. Another controversial topic is whether Arianespace should be able to bid for launches of U.S. Government satellites. Officially this issue is not a subject of the negotiations, but is often raised nonetheless.

Current U.S. policy requires U.S. Government satellites to be launched on U.S. launch vehicles. Arianespace wants that restriction lifted. Charles Bigot, Arianespace's Chairman and Chief Executive Officer, noted in a 1990 interview that although Arianespace has 50-55 percent of "the market" for satellite launches, that market does not include U.S. Government satellites and therefore Arianespace actually launches only 15 percent of the total number of satellites placed in orbit.⁸⁵ "We are not complaining, but our American competitors have access to the American government market and we do not have this access. So we say the rules are not the same for everybody and we ask that they be changed."⁸⁶

U.S. observers counter that although France and other European governments apparently do not have written policies requiring the use of Ariane for their government satellites, a de facto policy exists nonetheless.⁸⁷ Steven Dorfman, a corporate vice president for satellite manufacturer Hughes Aircraft, Inc., extends the criticism to satellites. He asserts that European governments (and China) will not purchase American-made satellites and that if Europe wants to sell launch services in the U.S., they should be prepared to procure launch services and satellites on a free-market basis.⁸⁸ Others note that the

⁸⁴ Lawler, Andrew and Peter B. de Selding. *ESA: U.S. Agenda is Too Broad*. Space News, Apr. 1-7, 1991. p. 4, 21.

⁸⁵ It is not clear what satellites are included in Bigot's definition of the potentially available market. In 1990, for example, Arianespace launched only 15 of the 165 satellites launched by the United States, Soviet Union, ESA/Arianespace, China, India, Israel and Japan, which is much less than 15 percent. If Soviet satellites were excluded, Arianespace would have launched 15 of 70 satellites, more than 15 percent.

⁸⁶ Aerospace America, op. cit., Jan. 1991, p. 6.

⁸⁷ There is at least one exception. The British Ministry of Defense used a commercial Titan for launch of a Skynet military communications satellite in 1990. Also in 1990, a German scientific satellite, ROSAT, was launched on an American launch vehicle, but this was a cooperative science program, not a commercial arrangement. Similarly, the U.S./French TOPEX oceanographic satellite will be launched on Ariane even though the U.S. Government is involved in the satellite.

⁸⁸ Trade Rep Urged to Consider Satellites with Launchers in ESA Talks. Aerospace Daily, Oct. 19, 1990. p. 116.

Europeans do not purchase U.S. launch vehicle components, either--all Ariane parts are made by European companies.

The issue of whether or not U.S. Government satellites could be launched on foreign launch vehicles became controversial during deliberations on the FY1992 NASA authorization bill that passed the House on May 2, 1991 (H.R. 1988). Some Members wanted to permit foreign launches of certain NASA environmental satellites (part of the Mission to Planet Earth program) because the U.S. could not launch mid-sized satellites into polar orbits. Such launches take place from Vandenberg Air Force Base, CA, and there is no launch pad there for the new Atlas launch vehicle (Atlas IIAS) required for "medium" sized spacecraft. Rather than being forced into building either much larger satellites that would take advantage of the Titan's substantial lift capability or smaller satellites sized to fit on Delta, the Members recommended flexibility on the issue of using foreign launch capabilities. Other Members, however, were concerned about the effect this might have on the U.S. commercial launch industry and on the trade talks with ESA. Ultimately, Representative Torricelli succeeded in amending the NASA authorization bill so it states that existing U.S. policy should be maintained, a waiver from the President should be required for any exemption to the policy, and exemptions only should be granted if the U.S. does not have the needed launch capability, U.S. companies would not be harmed by the waiver, and program benefits would accrue. Representative Torricelli recommended that a launch pad be built at Vandenberg for the new Atlas launch vehicle to remedy the problem, and suggested that the Department of Defense "contribute" to paying for its construction.⁸⁹ DOD subsequently announced plans to request funding to refurbish a launch pad at Vandenberg so it can support Atlas IIAS launches.

CHINA

China offers launch services through the China Great Wall Industry Corporation (CGWIC) on its Long March family of rockets. One commercial launch has been conducted to date (Asiasat 1, discussed below),⁹⁰ and contracts to launch two Aussat communications satellites (owned by Australia) and a

⁸⁹ See the House Science, Space and Technology Committee's report, H. Rept. 102-41, p. 21; and the floor debate on the FY1992 NASA Authorization Bill, Congressional Record, May 2, 1991, p. H2716-2717

⁹⁰ The French company Matra and the West German consortium Intospace each launched materials processing experiments on Chinese rockets (in 1987 and 1988 respectively), but since they were purchasing space aboard a satellite rather than a launch service per se, it is not counted here as a commercial launch services agreement. The experiments were launched by the Long March 2C, which can place 2,500 kg into low Earth orbit; the launches were from Jiuquan.

small Swedish scientific satellite (Freja) in 1992 have been signed.⁹¹ The Chinese had a contract to launch a communications satellite for the Arabsat consortium in 1991, but the arrangement fell through and the satellite now apparently will be launched by Arianesp. The Chinese launched a Pakistani test satellite in 1990, but there is no indication that this was a commercial arrangement.

How successful CGWIC will be in selling launch services depends on several factors. The availability of launches in the near-term is an advantage, and low prices also would attract customers. However, if the U.S. or other governments conclude that the low prices constitute unfair trade practices, they could choose to deny export licenses for the satellites. The lack of a significant track record for the launch vehicles also is a disadvantage; the Long March 3 has been successfully launched only 6 times (plus one failure), and the Long March 2E made its maiden flight in 1990. Political issues, such as the perceived stability (or instability) of the Chinese government, and U.S. dissatisfaction with China's ballistic missile proliferation policies, may also influence potential customers.

Chinese Launch Sites and Vehicles

From 1970 through September 1, 1991, the Chinese completed 28 successful launches, with 3 acknowledged failures.⁹² The Chinese have three launch sites: Xichang in the southeastern part of the country (28°N, 103°E) for launches to geostationary orbit; Shuang Cheng-tzu, or Jiuquan, in the Gobi desert in the northern part of the country (41.2°N, 100.1°E) for low Earth orbit launches; and a site at Taiyuan, near Beijing, for launches to polar orbit (38°N, 112°E). Among the vehicles now offered are the Long March 3 that can lift 1,350 kg to GTO, and the Long March 2E that can place 8,550 kg in LEO or 3,150 kg in GTO. The Long March 2C and the Long March 4 have been used as well and presumably would be made available if customers



⁹¹ Freja is designed to study the upper ionosphere and lower magnetosphere. It is scheduled for launch between July and Oct. 1992 on a Long March 2C as a secondary payload along with a Chinese remote sensing/microgravity research satellite.

⁹² For years, the Chinese made no public announcement of failed launch attempts, so the actual number of failures cannot be known with any certainty.

wanted them. The Chinese offer launch insurance through the Peoples Insurance Company.

Export Licenses for Asiasat and Aussat and the U.S.-China Agreement on Launch Services

Since 1988, a controversial aspect of Chinese launch services has been the issue of launching U.S.-built satellites on Chinese launch vehicles. Even before the 1989 Tiananmen Square uprising, opposition existed to allowing U.S.-built satellites on Chinese launch vehicles either for technology transfer or economic competitiveness reasons.

The first export license requests were made in 1988 to the U.S. Department of State to send U.S. satellites to China for launch. The requests were for two Australian satellites, AUSSAT 1 and 2,⁹³ being built by Hughes Aircraft, and one satellite named Asiasat-1, which is the refurbished Westar 6 satellite (also built by Hughes) recovered by a space shuttle crew in 1984 after it failed to achieve the proper orbit. Asiasat, Inc., which bought Asiasat-1, is a company owned by three entities, each having a one-third share: Cable and Wireless PLC of London, Hutchinson Telecommunications Ltd. of Hong Kong, and CITIC Technology, Inc., a subsidiary of China's International Trust and Investment Corporation. Cable and Wireless has overall management responsibility for Asiasat; the company is based in Hong Kong.

In September 1988, the Reagan Administration conditionally approved export of the three satellites to China. The conditions were (1) that China sign three international treaties concerning, among other things, liability for damage from space launches; (2) that China negotiate a fair trade agreement with the U.S. regarding launch services; and (3) that agreement be reached on protecting technology while each satellite is in China.⁹⁴ All these conditions were met by January 1989. China agreed that it would seek to launch no more than 9 international satellites between 1989 and 1994, and that it would charge prices "on a par" with prices prevailing in the international marketplace. The phrase "on a par" was not further defined.

Approval for the export of the AUSSAT and Asiasat satellites was granted by CoCom, the Coordinating Committee on Multilateral Export Controls, in

⁹³ The steps which led to the choice of China to launch the AUSSATs are detailed in: Pike, Gordon. *Chinese Launch Services: A User's Guide*. Space Policy, May 1991. p. 103-115.

⁹⁴ Under the terms of the Arms Export Control Act, Congress could have passed a resolution of disapproval within 30 days of Administration notice that it intended to grant the licenses. Hearings were held by the House Committee on Science, Space and Technology and the House Committee on Foreign Affairs, but no resolution of disapproval was passed.

March 1989.⁹⁵ Following the Tiananmen Square uprising in June, however, the Bush Administration suspended all export licenses for items on the Munitions Control List, including the three satellites. Congress passed legislation (P.L. 101-162, the FY1990 Appropriations Act for the Departments of Commerce, Justice and State and the Judiciary; and P.L. 101-246, the FY1990-1991 Foreign Relations Authorization Act) prohibiting the export of the satellites unless conditions improved in China,⁹⁶ or unless the President certified to Congress that it was in the national interest of the U.S. to reinstate the licenses. On December 19, 1989, the President made that certification to Congress. Asiasat was launched by China in April 1990.

The two AUSSAT satellites are still under construction in California and are scheduled for launch in 1992. On March 15, 1991, their export licenses expired. President Bush approved renewal of the licenses, along with approving export of the Swedish Freja scientific satellite (which contains U.S. components), on April 30, 1991. In accordance with the language in the FY1990-1991 Foreign Relations Authorization Act (see above), which is in force through September 30, 1991, the President certified to Congress that the exports were in the national interest of the U.S.⁹⁷

Linkage Between Missile Proliferation and Satellite Exports

At the same time it renewed the AUSSAT licenses and approved Freja's export, however, the White House made clear that it was concerned about China's missile proliferation policies and linked export of space technology with changes in those policies. The President denied the export of satellite electronics components made by a U.S. company (M/A-COM) that China wanted for a communications satellite it is building (Dong Fang Hong 3). Presidential spokesman Marlin Fitzwater stated that "certain activities of Chinese companies raise serious [missile] proliferation concerns" and that the U.S. is engaged in "an

⁹⁵ Cocom members are all the NATO countries (except Iceland), Australia and Japan.

⁹⁶ Specifically, the Act states that China must make progress on a program of political reform including: lifting of martial law, halting of executions and other reprisals against individuals for the nonviolent expression of their political beliefs; release of political prisoners; increased respect for internationally recognized human rights, including freedom of expression, the press, assembly, and association; and permitting a freer flow of information, including an end of the jamming of Voice of America and greater access for foreign journalists.

⁹⁷ U.S. Congress. House. Communication from the President of the United States. Approving Exports for the AUSSAT and Freja Projects. House Doc. 102-75. May 1, 1991.

intensive dialogue" with China about observing internationally accepted guidelines on missile and missile-related technology exports.⁹⁸

On June 16, 1991, the White House announced that because of China's missile proliferation policies, it would be "inappropriate for the U.S. to approve any further export licenses for commercial satellite launches at this time."⁹⁹ A month later, the Department of State identified CGWIC as one of two Chinese entities engaged in missile technology proliferation activities that require the imposition of trade sanctions in accordance with the Arms Export Control Act, including denial of license applications for export items covered by the Missile Technology Control Regime.¹⁰⁰ Although the MTCR does not cover satellites (only satellite launch vehicles which are essentially interchangeable with ballistic missiles), the identification of CGWIC as a cause of concern to the U.S. Government will certainly complicate China's commercial space launch services marketing plans.

Controversy Over the Arabsat Agreement

In March 1990, Arianespace charged that CGWIC had reached agreement to launch the Arabsat 1-C satellite for the Arabsat Consortium for a price below fair market prices in contradiction to the agreement China signed with the U.S. Chinese officials confirmed that their price was \$25 million, approximately half of what would be normally charged by Arianespace or a U.S. company, although they asserted that they had no choice because Arianespace lowered its offer to \$34-35 million.¹⁰¹ The Arabsat satellite was built by a European company (Aerospatiale), but a U.S. company (Space Systems/Loral--formerly Ford Aerospace) was a major subcontractor and approximately 60 percent of the components are American-made.¹⁰² Thus, Arianespace appealed to the French and U.S. Governments to deny an export license for the satellite.

Trade talks between the United States and China were already scheduled for July 1990 and according to press reports, the U.S. raised this issue. U.S. delegation leader Donald Phillips, from USTR, was quoted as saying that the

⁹⁸ Statement by Press Secretary Fitzwater on Restrictions on U.S. Satellite Component Exports to China, Apr. 30, 1991. In: Weekly Compilation of Presidential Documents. Administration of George Bush. v. 27, no. 18, Friday, May 3, 1991. p. 531.

⁹⁹ White House Fact Sheet, June 16, 1991.

¹⁰⁰ Imposition of Missile Proliferation Sanctions Against Chinese and Pakistani Entities. Public Notice 1423. Federal Register, v. 56, No. 137, July 17, 1991, p. 32601.

¹⁰¹ de Selding, Peter. China Maintains Innocence in Launch Price Policy Spat. Space News, Sept. 10-16, 1990. p. 1, 19.

¹⁰² Lawler, Andrew. U.S. Urged to Protest Arabsat Launch. Space News, Mar. 26-Apr. 1, 1990. p. 29.

Chinese "presented information and their own rationale" for their actions, and that the issue is "still under review."¹⁰³ The White House commercial space launch policy issued a month later said only that "There also must be an effective means of enforcing international agreements related to space launch goods and services."¹⁰⁴ The National Space Society (NSS), a grass-roots space advocacy group, filed a draft petition under Section 301 of the 1974 Trade Act demanding that the agreement with China be enforced, although a formal petition was never filed. Since the U.S. has decided not to approve export licenses for other reasons (discussed above), NSS is not pursuing the issue at this time.¹⁰⁵

On February 20, 1991, the Senate passed S. 320, the Omnibus Export Amendments Act of 1991, which contains language (section 126) prohibiting export of U.S.-made satellites to China for launch unless the President certifies that China is adhering to the launch services agreement it signed with the U.S. in 1989. The language is identical to that contained in H.R. 4643, the Export Facilitation Act, which passed Congress in 1990, but was vetoed by the President. (The language in H.R. 4643 was in an amendment sponsored by Representative Solomon during House consideration of the bill on June 10, 1990. During the debate, Representative Solomon said that he did not intend to affect the AUSSAT export licenses.)¹⁰⁶ House action on S. 320 is pending.

Regarding the Arabsat contract, Chen Shouchun, vice president of CGWIC asserted that Arianespace, not China, charges unfair prices.¹⁰⁷ For example, he noted that it took only 18 months to develop the Long March 2E booster (the newest version), compared to the 3-4 years it would have taken in the West.¹⁰⁸ Therefore, CGWIC can charge lower prices that nevertheless accurately reflect its costs. He also stated that Ariane has had more failures than Chinese launch vehicles and those costs must be borne by customers. From his point of view, China was abiding by the terms of the U.S.-China agreement. Lin Huabao, deputy chief of engineering at the Chinese Academy of Space Technology (attached to the Ministry of Aerospace Industry), went further in stating that the U.S.-China agreement itself is unfair. "China is a sovereign country. There

¹⁰³ Quoted in: Group Seeks Launch Satisfaction. Space News, July 30-Aug. 5, 1990. p. 2.

¹⁰⁴ The White House. Office of the Press Secretary. Fact Sheet: Commercial Space Launch Policy, Sept. 5, 1990.

¹⁰⁵ Telephone conversation with NSS representative, Sept. 13, 1991.

¹⁰⁶ Congressional Record, June 6, 1990, p. H 3302.

¹⁰⁷ Chen Shouchun, Vice President of Great Wall Industry Corp., quoted in: Chen Gengtao. Defending Chinese Launch Pricing. Space News, Aug. 20-26, 1990. p. 15.

¹⁰⁸ Ibid., Chen Gengtao.

should not be any limits imposed by outside governments like this. For a sovereign nation, this is not a good thing."¹⁰⁹

This particular issue became moot in the spring of 1991 when the Arabsat consortium terminated the contract with CGWIC and subsequently signed with Arianespace for the launch. The Arabsat Consortium has not revealed what led to the change in plans, nor have any of the parties revealed Arianespace's price. One media report asserted that the change was due "at least in part to Arabsat's realization that the infrastructure/support required to launch on Long March would be more complicated and expensive than originally anticipated."¹¹⁰ A Chinese space official, Zhang Jianye, asserts that "Aerospatiale acted in a very unfriendly and unfair way," delaying action to apply for an export license, and substantially inflating the charges it would assess the Arabsat Consortium for launch support services.¹¹¹ Zhang alleges that Aerospatiale would have charged four or five times as much as Hughes charged for supporting the Asiasat launch in 1990. An Aerospatiale representative countered that the company had made an "exhaustive study" of how much support would be needed to assure a successful launch and determined its charges accordingly.¹¹²

At about the same time, the Indonesian government selected an American company, McDonnell Douglas, over CGWIC and Arianespace for launch of a Palapa communications satellite. The issue garnered much interest because CGWIC had indicated willingness to accept goods (such as oil) in lieu of cash to pay part of the price.¹¹³ Western reports indicated that some of the Indonesian government's rationale in choosing McDonnell Douglas was uncertainty about whether the U.S. would issue an export license if CGWIC were selected. China's Zhang argues that the U.S. Government pressured the Indonesians not to choose a Chinese launch vehicle; a Department of State official responded that the Indonesians asked for the Department's advice and were given no recommendation, but "all the hoops" through which the export license request would have to go were explained.¹¹⁴

¹⁰⁹ Quoted in: de Selding, Peter. Chinese: Launch Accord Unfair. Space News, Apr. 30-May 6 1990. p. 20.

¹¹⁰ Arabsat Switched to Ariane. Aviation Week and Space Technology, May 20, 1991. p. 27.

¹¹¹ de Selding, Peter. China Retains Launch Interest. Space News, June 24-July 7, 1991. p. 28.

¹¹² Ibid.

¹¹³ de Selding, Peter. Indonesia Negotiates Launch-for-Oil Deal to Loft Satellite. Space News, Feb. 25-Mar. 3, 1991. p. 3.

¹¹⁴ de Selding, Peter. China Retains Launch Interest. Space News, June 24-July 7, 1991. p. 28.

SOVIET UNION

Soviet attempts to market launch vehicle services date back to 1982 when they succeeded in signing up one customer, India, for launch of a remote sensing satellite called IRS-1 (previously the Soviets had launched Indian satellites for free).¹¹⁵ A new agreement was signed in 1988 for the 1991 launch of IRS-1B,¹¹⁶ and two more contracts were signed in 1991--for the 1994 launch of IRS-1S and for a 1995 communications satellite launch (called Gramsat).¹¹⁷ The Indians paid 75 million rupees (\$3 million at today's exchange rate) for the IRS-1 launch¹¹⁸, and \$20 million for IRS-1B.¹¹⁹ The Indian Government has stated that the contract for launching IRS-1C is 30 crore (300 million) rupees (\$11.6 million).¹²⁰ The price for launching Gramsat has not been made public.¹²¹ The only other known commercial launch agreement the Soviets have signed so far is with the U.S. company Energetic Satellite Corporation for secondary payloads (discussed below).¹²²

The Soviet organization Licensintorg has been responsible for marketing launch vehicle services with help from Glavcosmos, the Soviet civilian space

¹¹⁵ The satellite was successfully launched in 1988.

¹¹⁶ IRS-1B was successfully launched in August 1991.

¹¹⁷ Satellite for Educational Purposes to be Launched with India. *Ekonomika i zhizn*, Feb. 1991, p. 2; and Indians and Soviets Agree Timetable for IRS Launches. *Flight International*, Feb. 13-19, 1991. p. 19.

¹¹⁸ Moscow Domestic Service, 0900 GMT, Oct. 4, 1988. In Soviet Union Daily Report, Foreign Broadcast Information Service (FBIS), Oct. 5, 1988. p. 75.

¹¹⁹ Moscow Television, as quoted in: Soviet Space Launched Slowed by Tight Budgets, Declining Threat. *Aerospace Daily*, Sept. 5, 1991, p. 364. The price was stated in dollars.

¹²⁰ Delhi All India Radio Network, 1430 GMT, 2 Sep 91. In Foreign Broadcast Information Service. NES-91-171, 4 September 1991, p. 48.

¹²¹ These satellites contain no U.S. components. Other Indian satellites that do contain U.S. components, such as the INSAT 1 communications/meteorological satellites, are launched by U.S. or European launch vehicles.

¹²² As with China, companies that have launched materials processing payloads on Soviet spacecraft are not included here since they were purchasing space aboard the spacecraft, not the launch service itself. Matra and Intospace have each launched experiments on Soviet satellites, and a U.S. company (Payloads Systems, Inc.) paid to place an experiment on the Soviet space station Mir in 1989. Also not included is a potential cooperative agreement (i.e., non-commercial) between the Soviets and the Space Studies Institute in Princeton, N.J. for launch of a lunar probe (Lunar Prospector) the Institute hopes to develop privately. It would be launched as a secondary payload.

agency, which is part of the Ministry of General Machine Building. With the dissolution of the Soviet Union in the wake of the attempted coup in August 1991, the future of Glavcosmos and Licensintorg is uncertain.



Soviet Launch Sites and Vehicles

The Soviets have several different launch vehicles (Vostok, Soyuz, Molniya, Cosmos, Cyclone, Zenit, Proton, and Energiya) and all are available for commercial use. Prices range from \$10 million for Cyclone to \$28-35 million for Proton (the lower price is for launches into low Earth orbit; the higher price for geostationary orbit).¹²³ The prices for Zenit and Energiya, the newest of the Soviet launch vehicles, are unknown. (See below for more information on Zenit.) The Soviets also offer launch insurance.

Using all its vehicles, the Soviets historically conduct up to 100 launches per year from its two main launch sites: Tyuratam, also called the Baikonur Cosmodrome, in the Republic of Kazakhstan near the Aral Sea (45.6°N, 63.4°E) for low and medium Earth orbit launches and launches to geostationary orbit; and Plesetsk, in the Russian Republic near the Arctic Circle (62.8°N, 40.1°E) for low Earth orbit/polar orbit launches. A third site at Kapustin Yar (48.4°N, 45.8°E), also in Russia, has not been used for orbital launches for several years.

¹²³ de Selding, Peter. Finnish Firm Offers Soviet Space Service at 30 Percent Off. *Space News*, Apr. 23-29, 1990. p. 7.

The Proton, Zenit and Energiya boosters have received the most publicity. Proton entered service in 1965, and can place 20,000 kg in low Earth orbit, or 2,200 kg in GEO. It is used for all space station launches (the Salyut series and the current Soviet space station, *Mir*), and for placing Soviet communications satellites in GEO. Zenit is a new launch vehicle, and in its two-stage form, the Soviets have used it for launches into low Earth orbit (15,000 kg) since 1985. The two most recent Zenit launches failed, however (October 4, 1990 and August 30, 1991).¹²⁴ As discussed below, an Australian company wants to upgrade Zenit so it can place satellites in geostationary orbit. Energiya, which can place 100,000 kg in low Earth orbit, has been launched only twice. The vehicle consists of a core vehicle plus four "strap-ons," which are one-stage Zenits. The May 15, 1987, Energiya launch is categorized as a failure because the payload did not reach orbit, but the Energiya itself apparently worked as planned; the failure was in an engine on the payload. The second launch, on November 15, 1988, successfully carried the Soviet space shuttle *Buran* into space (without a crew).

In addition to comparatively low prices, another advantage the Soviets could offer is short response time in launching payloads. Since they launch so often, finding a launch opening for a particular satellite should prove easier than for the U.S. or Europe which launch less frequently. The major disadvantages are U.S. policy (see below), and at least for the Zenit and Energiya, reliability.

U.S. Position on Launching Satellites from the Soviet Union

The major obstacle for the Soviets in becoming players in the launch services market is U.S. policy. In 1988, the U.S. Department of State decided that satellites containing U.S. components cannot be launched on Soviet launch vehicles because of technology transfer concerns.¹²⁵ The U.S. prohibition affects virtually all communications satellites in the free world, since U.S. companies are usually the prime contractors or subcontractors for building communications satellites.

In response to the U.S. concerns, the Soviets announced that satellites would be exempted from customs inspections when entering the Soviet Union, and that representatives of the satellite owner could stay with the satellite

¹²⁴ The October 4, 1990, launch failure also destroyed one of the two Zenit launch pads.

¹²⁵ U.S. Department of State Denies License to Export U.S. Satellites to the Soviet Union. *Aviation Week and Space Technology*, July 27, 1987. p. 59; and Secretary of State Shultz Reaffirms Ban on Proton Launcher. *Space Commerce Bulletin*, Oct. 9, 1987. p. 2.

through launch,¹²⁶ but the U.S. Government has not changed its position. In fact, the U.S. went further in the September 1990 commercial space launch policy by permitting U.S. participation in the Cape York proposal (see below) only if the Soviets agree not to conduct commercial launches from inside the Soviet Union at all.

Although technology transfer may be, in fact, a matter of concern to the U.S. Government, economic competition is another major motivation driving U.S. policy formulation. As with China, the concern is that the Soviets might offer extremely low prices for their launch services since they have a non-market economy and therefore can charge whatever they wish for the launch. The Soviets have retained a U.S. company, Space Commerce Corporation (SCC) of Houston, Texas, to help in marketing Soviet launch services (and other products and services) in the U.S.¹²⁷ SSC representatives insist that the price for launches would be at fair market value. Art Dula, President of SCC, has even quipped that "we'll leave the price blank in the contract and the U.S. Department of State can fill it in."¹²⁸ It is too early to tell whether U.S. Government policy will change because of the breakup of the Soviet Union in the aftermath of the August 1991 coup.

Energetic Satellite Corporation

Despite the U.S. stance, Space Commerce negotiated an agreement in 1989 between the Soviets and a U.S. company called Energetic Satellite Corporation. The contract reportedly is worth \$54 million and involves two launches, with an option of six more, beginning in late 1990 (although no such launches have taken place yet). The satellites, called SAT/TRAC, are for navigation and would

¹²⁶ Spacecraft to Launch U.S. Commercial Payload. Moscow in English to North America, 2300 GMT, 2 Mar. 1988. In Soviet Union Daily Report, FBIS, Mar. 3, 1988. p. 59.

¹²⁷ In July 1989, Space Commerce and Technopribor of the Soviet Union signed an agreement to jointly develop and market a new commercial mobile launch vehicle derived from the Soviet SS-20 medium-range missile. Called Start, it would be capable of carrying a 650 kg payload to low Earth orbit at an estimated cost of \$4-5 million per launch. SS-20s are to be eliminated under the terms of the Intermediate-range Nuclear Forces (INF) treaty, so the proposal has generated concern in the U.S. Government that the Soviets could use this commercial arrangement to continue to produce SS-20s. Space Commerce asserts that it would be a completely new design, and would simply use the production facilities that had been used for the SS-20. See: Morrocco, John D. U.S. Soviet Firms to Develop, Market Commercial Booster Based on SS-20. Aviation Week and Space Technology, Aug. 7, 1989. p. 21.

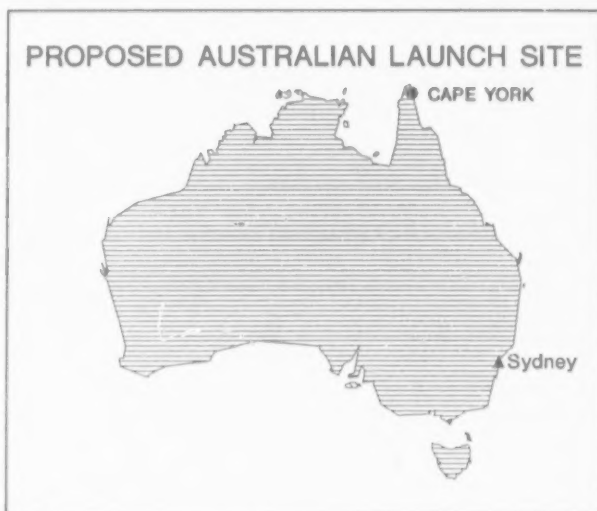
¹²⁸ Huntington, Tom. Soviet Booster. Air and Space, Feb./Mar. 1991. p. 93.

be launched as secondary payloads using the Proton launch vehicle.¹²⁹ The price for each launch is \$6.5 million and the company asserts that there should be no technology transfer concerns since the satellites use well known technology. No export license has been issued yet.

Cape York

Although U.S. policy regarding launches of satellites with U.S. components from the Soviet Union is unchanged, in the summer of 1990, the Bush Administration relaxed its position with regard to launches on Soviet boosters from some other country.

The impetus was a proposal by an Australian company, the Cape York Space Agency (CYSA, which is privately funded and not part of the Australian government), to build a launch site at Cape York, Australia.¹³⁰ CYSA wants to use the Soviet Zenit boosters for geostationary launches from Cape York, and argues that there would be no technology transfer concerns because the satellites would be exported to Australia, not the Soviet Union, and no Soviets would be involved with the launch. Current planning calls for the launch site to be operational in 1996.



There are many challenges facing the Cape York proposal. First and foremost, Essington Developments, CYSA's parent company, experienced financial difficulties in 1990 and announced plans to sell CYSA. The Australian government asked the Australian Industry Development Corporation to determine if there were other companies that might be interested in investing in the plan, a review that is still taking place.¹³¹ Assuming that new investors are found, other hurdles must be cleared before a decision can be made on

¹²⁹ That means that the Proton would have as its main task launching some other satellite, and the Energetic satellites would ride along since they would not require the full capability of the Proton. This is also called "piggybacking."

¹³⁰ The Australians operated a launch site at Woomera (31°S, 137°E) in the 1960s and early 1970s. The range has been inactive for two decades, but there now is a proposal to reopen it for commercial sounding rocket launches.

¹³¹ Australian Govt. Resurrects Plans for Private Spaceport at Cape York. Space Commerce Week, Aug. 16, 1991, p. 2.

building the launch site, such as completing environmental impact studies. The failures of the two most recent Zenit launches (discussed earlier), and the fact that Zenit does not now exist in a configuration capable of launching satellites to geostationary orbit (a third stage would be required, and CYSA is looking at a variety of alternatives, apparently including U.S. rocket stages), may also hamper the project's progress. Despite CYSA's uncertain status, it is informative to review the history of the proposal to date as an illustration of the issues involved in such a proposition.

As already noted, decisions on commercial space launch services competition often are based more on economics than technology transfer concerns. While some observers doubt that CYSA could launch Zenit boosters without Soviet technicians on site, and therefore still express concern about potential technology transfer, the greater concern is that the Soviets could offer very low prices and undercut U.S. and European companies.

CYSA wants technical assistance from a U.S. company, U.S. Space Boosters, Inc., (USBI, a division of United Technologies), in developing plans for the launch site and, ultimately, operating it. According to USBI, the price of the launch would include costs associated not only with procuring the launch vehicle and ground support equipment, but in building and maintaining the launch site. USBI estimates that a Zenit launch from Cape York would cost \$75-80 million.¹³²

USBI needs an export license to provide technical assistance to CYSA.¹³³ In August 1990, President Bush conditionally approved the export license application by USBI to participate in engineering, program management and development work for Cape York. The August announcement, together with the commercial space launch policy released in September 1990, set the following conditions. USBI, the Australian Government, the Soviet government, and CYSA must reach agreement that: the Soviets provide launch services from only one launch site outside the Soviet Union and not conduct commercial launches of Western satellites from inside the Soviet Union; the Soviet Union and Australia abide by the international agreement controlling the export of ballistic

¹³² Supporters Say Cape York Plan Wouldn't Hurt U.S. Booster Companies. *Aerospace Daily*, July 10, 1990. p. 43.

¹³³ Although USBI actually requested a Technical Assistance Agreement (TAA) rather than an export license, Congress included language in the FY1990 Dire Emergency Supplemental Appropriations Act (P.L. 101-302) stating that for the purposes of section 610 of P.L. 101-162, an export license application includes requests for technical assistance agreements. Therefore, Congress must be given 30 days to disapprove the license in accordance with section 38 of the Arms Export Control Act, and the associated International Traffic in Arms Regulations.

missile technology (the Missile Technology Control Regime);¹³⁴ and all parties observe U.S. laws on transfer of militarily significant technology to the Soviets.¹³⁵ If USBI wants to proceed with CYSA in the construction or operation of the Cape York facility, it would have to reach additional agreement that CYSA would abide by fair market practices in the pricing of launch services. How the U.S. would enforce such an agreement is a subject of debate, especially in light of the issue regarding whether China is following the terms of the agreement it made with the U.S.

The U.S. Congress included language in the FY1990 Commerce, Justice, State and Judiciary Appropriations act (P.L. 101-162, section 610) prohibiting the expenditure of funds in the act for approval of license applications for launches of U.S.-built satellites on Soviet-built launch vehicles unless the President makes a report to Congress that such an approval would be in the national interest of the U.S. This language expired at the end of FY1990.

U.S. policy is an important factor in the fate of Soviet efforts to market commercial launch services; whether it will change because of the dramatic events in the Soviet Union that were occurring as this paper was being written remains to be seen. Other factors will include the demand for launch services versus the supply of service providers (many observers feel that there is too much supply for the demand) and whether the Soviets, through CYSA or some other entity, have a product worth buying. The recent Zenit failures, and the lack of a version capable of placing payloads in geostationary orbit, are serious impediments.

¹³⁴ For a discussion of the MTCR, see: Shuey, Robert D. et al. *Missile Proliferation: Survey of Emerging Missile Forces*. Washington, U.S. Library of Congress, Feb. 3, 1989. CRS Report 88-642 F (revised).

¹³⁵ Rains, Lon. *Bush Gives Nod to American Participation in Cape York*. Space News, Aug. 27-Sept. 2, 1990. p. 4.

CHAPTER 7

ISSUES

CAN THREE MAJOR U.S. COMPANIES SURVIVE?

The consensus of the Western launch vehicle manufacturers is that there will be 15-25 commercial satellite launches per year over the next decade.¹³⁶ Given this market and the possibility that the market may be smaller, an oversupply of services may force some launch companies to leave the market.

Commercial launch opportunities for large capacity payloads might be divided among many international competitors that include three U.S. firms, Europe, China, the Soviet Union, and possibly Japan. As a result, the demand for launch services may not sustain a healthy U.S. launch industry. In addition to concerns about whether the Soviet Union and China will charge fair market prices, some in U.S. industry are also worried about Europe's Ariane 5. With \$5 billion of European investment in the program, a stated goal of 40 percent reduction in cost-per-kilogram to orbit over the Ariane 4, and no requirement to recover the investment, many believe that no U.S. firm will invest the amount of private funds necessary to develop a vehicle to compete with the capacity and price of the Ariane 5.

What is really at stake is market share in a satellite launching business that is rapidly approaching saturation. The U.S. commercial launching business is off to a good start as it fills its orderbooks with the backlog caused by the *Challenger* accident. Latest projections currently show a potential market for 19 uncommitted payloads through 1994.¹³⁷ This is in addition to 34 signed up by Arianespace and 20 by U.S. firms. The decisive period for companies may occur as the backlog is consumed, and as the role of launchers from China and the Soviet Union become better defined. Also, as the new fiber optic

¹³⁶ Near-Term Launch Market Looks Bright, But Questions Remain on Future Prospects. *Aviation Week and Space Technology*, Dec. 19, 1988. p. 73.

¹³⁷ Personal conversation with General Dynamics spokesperson, July 9, 1991.

transatlantic cables enter service,¹³⁸ and as operational lifetimes are extended in new generations of satellites, the demand for satellite launches may diminish. In the next five years the three large U.S. companies and Arianespace are expected to dominate the world commercial market backed by government payloads, but in the long term, as supply begins to pass demand, increased competitive pressure could reduce the number of companies offering commercial launches. How Government agencies decide to procure launch services may have a large impact on the survival of the three U.S. commercial launching firms.

The concern of some officials is how to protect the emergent U.S. launch services industry in the face of determined efforts from countries with low, controlled labor costs and an urgent need for hard currency. If the danger of technology transfer were real, one might expect that the satellite manufacturers would want to protect their trade secrets. Instead, U.S. satellite manufacturers have urged more open access to Chinese and Soviet launchers. So far, in the U.S. space industry, none of the major satellite manufacturers is deeply involved in launch manufacture and launch services, and none of the commercial launch manufacturers and operators has any commercial satellite business. Thus, the U.S. space industry is split between those firms which are trying to protect their launch services business, and those wanting quick access to orbit at the lowest possible price or with the satellite launcher of preference for their customer. Congress will find it rather difficult to protect both segments simultaneously. Any decision could hurt one part of the industry, and help another.

FEDERAL FUNDING OF LAUNCH VEHICLE TECHNOLOGIES

A Commercial Space Transportation Advisory Committee (COMSTAC) report issued in October 1990 (COMSTAC Innovation and Technology Working Group FY1990 Final Report), stated that in order to meet the competitive threat from foreign government-sponsored commercial launch vehicles, the United States will need to reduce costs and prices of domestic launch systems by 25 percent to 50 percent by the year 2000. The report further stated that these goals may be attainable if an aggressive program of NASA and Air Force support for ELV research and technology is implemented. In July 1990, NASA submitted a report to Congress (Expendable Launch Vehicles Technology Report) that defined a technology plan that might help make the U.S. launch industry more competitive.

The House and Senate versions of the NASA Authorization Act of 1992 (H.R. 1988) recommend authorizing \$10 million in FY1992 to initiate a

¹³⁸ Transatlantic fiber optic cables are an alternative to satellites for long distance communications. Fiber optic cables compete directly with satellites for communications.

commercial launch technology development program.¹³⁹ Some Members question, however, whether the U.S. Government should pay for research to develop new technologies specifically for the commercial launch sector. They contend that it is a form of subsidization that the U.S. Government should not provide. Other Members point out that ESA subsidizes technology development for the Ariane ELV and such research in the United States would put U.S. industry on the same level as Arianespace.

There is also the question of whether Federal funds should be spent on upgrading technologies of current vehicles or instead used for developing technologies for future vehicles such as the proposed National Launch System (NLS). Some believe it is more productive to invest funds in technology development for new vehicles instead of upgrading current vehicles that use old technology. Others believe the United States should invest in updating current vehicles in order to meet short-term competitiveness concerns. The United States might have to rely on current vehicles for a decade or more before a new vehicle could be developed.

LAUNCH INDEMNIFICATION

The Commercial Space Launch Act Amendments of 1988 (P.L. 100-657) contained a provision that the Government will indemnify third party claims to the degree the claims exceed the launch provider's insurance up to a total of \$1.5 billion per launch incident. This provision, however, expires November 15, 1993, five years after the amendments were enacted. Launch service contracts often have commitments for launches three years in advance. Launch firms that contract for launches beyond November 1993, do not know if the Government launch indemnification will be there. Supporters of the U.S. commercial launch industry believe that the indemnification expiration puts U.S. industry at a disadvantage in garnering future contracts since Arianespace does not have an indemnification expiration.

Opponents of indemnification believe that the Government should not be competing with the launch insurance industry. Most insurance industry officials concur, however, that the industry is not currently capable of covering all possible claims.¹⁴⁰ The insurance industry did not oppose the 1988 amendments because, at the time, the insurance market was unable to provide sufficient liability insurance to obviate the need for indemnification.¹⁴¹ The

¹³⁹ The House version passed May 2, 1991. The Senate version was reported from the Committee on Commerce, Science, and Transportation on July 2, 1991. As of September 1, 1991, the Senate version was awaiting floor action.

¹⁴⁰ Statement of William D. English, Counsel, American Space Transportation Association, before the House Committee on Science, Space and Technology Subcommittee on Space, July 17, 1991.

¹⁴¹ Statement of Patrick Rivalan, Senior Vice President of Space Underwriting, International Technology Underwrites Inc., before the House Committee on Science, Space, and Technology Subcommittee on Space, July 17,

conditions in the liability insurance market have not significantly improved since 1988, and because of failures in 1990 may have in fact worsened.¹⁴²

Supporters of indemnification believe that the Commercial Space Launch Act indemnification provision should be extended beyond November 1993. They believe such an extension is critical to the U.S. launch industry's commercial viability. Supporters also point out that the probable amounts of liability are already covered by the insurance industry. As stipulated in the 1988 amendments, the launch industry assumes the risk of "maximum probable loss" from public liability claims and claims from the Government for damage to its property. They believe that the risk to the Government of losses above the "maximum probable loss" level is remote, and extension of the indemnification authority represents a low cost, low risk way for the Government to support the launch service industry.

Although agreeing that an indemnification extension is needed, some supporters believe the extension should be for a finite length of time in order for Congress to periodically readdress the issue. They believe that a time may come when the insurance industry may be capable of covering all possible claims, eliminating the need for Government indemnification.

NASA's SOUNDING ROCKET POLICY

NASA's Office of Space Science and Applications (OSSA) provides grants to universities for developing space-based research experiments then offers suborbital launches for these experiments on sounding rockets built from surplus military and newly purchased motors.¹⁴³ NASA conducts around 30 of these launches per year and offers 15 different launch configurations.¹⁴⁴ Some Members believe NASA should purchase commercial launch services for these payloads instead of buying spare parts of sounding rockets and offering launches on its own. NASA believes that its approach is required to allow flexibility for the academic payloads and that it is unlikely that the private sector could offer the many configurations and number of launches that NASA provides. If NASA were to pursue commercial sounding rocket launches, NASA officials believe that a transition phase of some duration would be necessary to move the expertise that NASA and its contractors have in this area over to the

1991.

¹⁴² Ibid.

¹⁴³ Marcus, Daniel J. NASA's Sounding Rocket Policy Draws Congressional Fire. *Space News*, July 29-Aug. 4, 1991. p. 9.

¹⁴⁴ Ibid.

commercial sector.¹⁴⁵ NASA already is sponsoring commercial sounding rocket programs outside the OSSA effort through its Office of Commercial Programs.

DEFINITION OF A COMMERCIAL LAUNCH

In 1990, a disagreement arose between the DOT and NASA over the need to license the launching of the Combined Release and Radiation Effects Satellite (CRRES). DOT said that a license was necessary for all commercially procured launches, but NASA disagreed. James L. Womack, director of Expendable Vehicles at Kennedy Space Center, said "it will continue to be NASA's position that a Government payload does not require a Government license."¹⁴⁶ The two agencies were at odds over what constitutes a commercial launch and whether OCST has authority to license the flights of certain NASA payloads. Neither side could agree on the proper role of OCST in regulating NASA missions using commercially procured launch services.

Under the Commercial Space Launch Act of 1984, the OCST is responsible for regulating the U.S. commercial launch industry and is required to ensure that all commercial launches are licensed. However, NASA believes it must assert control over its own payload launches, and therefore does not believe it falls within the Department's purview. Both NASA and the DOT agree that under certain circumstances, the Government should take full responsibility for a launch. In those cases, DOT licensing would be unnecessary. For cases where the commercial firm supplies launch operations, however, DOT believes it is required to license the launch.

The whole disagreement stemmed from the Commercial Space Launch Act's definition of a Government launch. Commercial launches must be licensed, but Government launches need not be licensed by the DOT. The Act does not explicitly define the criteria of a Government launch. NASA's interpretation is a launch where the responsible Government agency has a large share of launch operation responsibility and assumes full responsibility for protecting the public health and safety, safety of property, national security, and foreign policy interests associated with that operation. According to NASA, the Mars Observer Mission in 1992 as well as all current NASA contracts for commercial ELVs would fall under this definition. NASA believes it is procuring commercial launch services, but that it is conducting a Government launch. DOT believes any launch procured in a commercial manner is a commercial launch.

Some believe NASA is fighting to retain its traditional control over civil spaceflights. The licensing issue affected other NASA missions that were listed

¹⁴⁵ Statement of Michael T. Lyons, NASA Deputy Associate Administrator for Space Flight, before the House Science, Space and Technology Subcommittee on Space, July 17, 1991.

¹⁴⁶ U.S. Congress. House. Committee on Science, Space, and Technology. Subcommittee on Space Science and Applications. Commercial Space Launch Act Implementation. Hearing, No. 98, 101st Cong., 1st Sess., Nov. 9, 1989. Washington, U.S. Govt. Print. Off., 1990. p. 60.

on the DOT commercial manifest. NASA will be sponsoring most civil Government missions that will rely on commercial launch services. For the CRRES launch, NASA had declared its jurisdiction over the launch, but DOT ordered General Dynamics, which was providing the launch services to NASA, to obtain a license. The license was granted May 17, 1990. DOT asserted that the licensing eliminated the need for launch companies to be certified by NASA under a different set of safety regulations.

In May 1990, NASA filed a ruling request with the Department of Justice to settle the conflict between the two agencies. On November 15, 1990, the Justice Department ruled in favor of NASA's position that a Government agency can be exempt from launch licensing for Government use of commercial launch vehicles. As a result, five NASA launches were removed from OCST's Commercial Launch Manifest and will not be licensed by OCST. NASA considers the matter closed, but OCST believes the ruling was a step backwards for the U.S. commercial launch industry. At a March 7, 1991, hearing before the Subcommittee on Space of the House Science, Space and Technology Committee, Stephanie Lee-Miller, director of OCST, stated that the ruling shows that the Government does not believe the U.S. commercial launch industry is competent enough to carry out the launches of Government payloads. Ms. Lee-Miller is concerned about the image this portrays to potential foreign users of U.S. commercial launch vehicles.

IS DOT DOING ITS JOB?

Some Members of Congress believe that the OCST has not shown the leadership it was assigned in the Commercial Space Launch Act of 1984 and its Amendments of 1988. In the Act, DOT was set up as lead agency to give stability to the industry so it could efficiently do its pricing and make long-term plans; some feel DOT has not acted like a lead agency.

In November 1989, OCST was criticized for acting too slowly in issuing guidelines for commercial launch companies regarding purchase of liability insurance. OCST has responded that they did not want to solidify regulations until they had some experience in licensing launches. In doing so, they might be able to issue regulations that took into account concerns of the commercial launch industry. Most members of the launch industry have stated that they did not feel there was a void of regulatory guidance in licensing area. They agreed with DOT's desires to proceed slowly so they could get feedback from companies on the licensing process. OCST has started economic impact studies to examine the effect of the regulations on the industry.

DOT also has been criticized for not reaching agreements with NASA on what constitutes a Government launch (see above). Some Members of Congress feel that the lack of discussion between DOT and NASA on the definition of Government launches again showed a lack of leadership in the agency. Other issues that have been raised are OCST's refusal to sign a flight certification for the first U.S. commercial launch in August 1989, and its not keeping track of

liability cross-waivers¹⁴⁷ required of the commercial launch companies its licenses. OCST responded that it refused to sign the flight certification because it did not feel it was part of its licensing responsibilities. The office requires that the launch operator certify that it has met all the requirements of its launch license, including obtaining the cross-waivers. OCST states that it would have been physically impossible to verify that all contractors had signed cross-waivers, and accepted the prime contractor's certification that all cross-waivers had been signed. Some Members of Congress believe that DOT, by not requiring certification of each cross-waiver signed, turned over a responsibility to the prime company that should have been the Government's.

COMMERCIAL LAUNCH USER FEES

On February 28, 1991, OCST issued a Notice of Proposed Rulemaking (NPRM) that proposed a schedule of user fees for activities involved in reviewing a launch license application and issuing a license for the conduct of commercial launch activities. Institution of the fee structure was required by Congress in the FY1991 Department of Transportation Appropriations Act (P.L. 101-516) which appropriated \$3.3 million for OCST in FY1991 and called on DOT to institute user fees that would generate an additional \$300,000 in order to bring the budget to \$3.6 million. The Office of Management and Budget had also given OCST orders to institute user fees for commercial launch licensing.

Under the fee schedule, launch operators would be charged \$2.50 per pound of payload lift capacity to recover part of the cost to the taxpayer of licensing commercial launches. Commercial suborbital launches would be assessed at a flat rate of \$1,000 each. OCST would also charge \$2,500 for an initial license application regardless of whether the license was granted, and an annual renewal fee of \$2,500. The per-launch fee would be payable within 30 days after a particular launch. Officials of the U.S. launch companies are concerned that the additional cost will add another hurdle to their efforts to win commercial launch contracts over foreign suppliers. The user fees would probably affect the U.S. firms' launch costs, and in turn lead to higher launch prices. Current commercial profit margins are low to nonexistent and levying user fees may further exacerbate the condition. There is also the concern by small launch vehicle providers that the fees will hurt their business disproportionately. OCST believes that the fee system will not act as a barrier to entry into the industry and will ease the payment process for new and entrepreneurial entrants.¹⁴⁸

CONDITION OF U.S. LAUNCH INFRASTRUCTURE

According to Air Force officials, the U.S. launch facilities are in dire need of repairs and improvements that could cost as much as one billion dollars over

¹⁴⁷ Cross-waivers are documents that make each contractor responsible for any property damage or loss it sustains.

¹⁴⁸ DOT Sets Launch User Fee at \$2.50 per pound of Lift Capacity. *Aerospace Daily*, Feb. 28, 1991. p. 354.

the next decade.¹⁴⁹ Some of the discrepancies, if not corrected, could result in mission failure during spacecraft processing, launch, and tracking and associated operations.¹⁵⁰ The Air Force Space Command has identified \$287 million worth of required repairs at Vandenberg and Cape Canaveral with \$40 million of this amount already spent to correct some of the most urgent problems.¹⁵¹ The majority of U.S. commercial launches are from Cape Canaveral, and many launch industry officials believe that the antiquated facilities add another disadvantage to the industry when it is compared with the modern launch facilities of Arianespace.

Air Force officials have made upgrading the launch facilities a top policy priority, but admit that tough budget times may prevent the full one billion dollars from being provided.¹⁵² Air Force Space Command has proposed a separate budget line of \$37 million annually, starting in 1994, for continuing maintenance and repair of the launch infrastructure.¹⁵³ Air Force officials have also stated that they fully intend to factor the needs of commercial industry into upgrade projects. There is also the issue of whether it is more effective to use limited funding for developing new launch sites for future launch systems such as the National Launch System (NLS) instead of refurbishing old launch sites.

Advocates of the U.S. commercial launch industry have pressed for a grant program administered by DOT that would provide money to states and state-sponsored groups to improve current infrastructure or build commercial space facilities or commercial spaceports. (See below for a discussion of commercial spaceports.) The House-passed NASA FY1992 Authorization bill (H.R. 1988) recommends authorizing up to \$20 million in DOT for "improvements to space transportation infrastructure." The provision, however, does not give DOT the authority to issue grants. Some Members have objected to providing grants because they view such grants as direct subsidies to the commercial space sector. The Administration's Commercial Space Policy prohibits the use of direct Federal subsidies. The Senate version of the bill (H.R. 1988) does not contain the \$20 million provision and is awaiting floor action as of September 1, 1991.

¹⁴⁹ Kiernan, Vincent. A.F. Launch Pad Work Needed in 1990s. *Space News*, Nov. 21-Dec. 2, 1990. p. 1.

¹⁵⁰ Kolcum, Edward H. USAF Civil Engineering Report Prompts Major Repairs to Delta Launch Complex. *Aviation Week & Space Technology*, June 24, 1991. p. 52.

¹⁵¹ Kiernan, Vincent. Aging Facilities Hamper Launches at Space Bases. *Space News*, Sept. 16-22, 1991. p. 3.

¹⁵² Koprowski, Gene. A Lift For Launches. *Washington Technology*, July 25, 1991. p. 4.

¹⁵³ Kiernan, Vincent. Aging Facilities Hamper Launches at Space Bases. *Space News*, Sept. 16-22, 1991. p. 3.

DEVELOPMENT OF COMMERCIAL SPACEPORTS

In September 1990, the Aerospace Industries Association (AIA) submitted a report to the Department of Transportation entitled *Commercial Space Launch Infrastructure: An Industry Perspective* which looked at the U.S. launch infrastructure from the commercial launch industry's perspective. In the report, Cape Canaveral's infrastructure was found to be antiquated. Other concerns identified in the report include: an excessive time for range reconfiguration to support one type of vehicle and then another; a lack of range staffing; a lack of commercial customer orientation, a labor intensive vehicle processing that results in long processing times; and a scheduling philosophy that allows the Government to preempt a commercial launch with a Government launch.¹⁵⁴

The development of commercial spaceports has been proposed to address some of the issues raised in the AIA report. State-assisted development of spaceports is seen as a way for attracting space industry and jobs to the States. The spaceport concept is also seen as an alternative for improving launch infrastructure conditions for the commercial launch industry. It is difficult, however, to assess the actual need for a commercial spaceport and whether public funding for such development would be seen as a Government subsidy. The costs today to a commercial user of the national launch sites only include the direct costs of using the site and not the development costs of the site. The user of a commercial spaceport, however, would also have to pay for developmental costs of the spaceport. The amount of the development costs that would be charged to each user would depend on the expected number of launches.

In the AIA report, it was stated that the expected slow growth in demand for medium and large rockets in the 1990s "is insufficient to justify the construction of a new commercial spaceport at this time." They felt that the commercial spaceport concept currently being considered would be more expensive to use than Cape Canaveral and other national ranges. Even if a commercial spaceport were constructed with a combination of Federal grants and State financing, AIA felt that "the user fees for commercial launches would be greater than exists now at the national ranges." AIA concluded that updating current launch infrastructure in the near-term was more beneficial to U.S. commercial launch competitiveness than developing a new commercial spaceport. The report, however, found a different situation for small rockets. If the commercial market for putting small satellites into orbit develops rapidly as some predict, the report stated that "a commercial spaceport may become justifiable since current infrastructure for small rockets is very limited." The costs of a facility for small rocket launches would probably be much lower than one for medium rockets and would involve shorter development times. Due to the current variance in market predictions, AIA felt that the growth of the commercial market for small satellites requires monitoring so that sponsorship of needed infrastructure occurs with appropriate leadtime.

¹⁵⁴ The report did state that there was no evidence that U.S. Government launches were given priority over commercial launches.

USE OF SURPLUS U.S. GOVERNMENT STRATEGIC MISSILES AS LAUNCH VEHICLES

The use of surplus strategic missile assets as launch vehicles first became an issue in 1990, when Lockheed Missiles and Space Co. proposed offering commercial launch services using a modified version of the Poseidon C-3 missiles that were being removed from active deployment. Lockheed needed approval from the Navy, which owns the missiles, before it could adapt the sea launched missile into a small land launch vehicle. Potential small launch vehicle competitors were not pleased with the Lockheed proposal because they believed that they would not be able to compete with the lower prices offered for converted missiles because of the Government money that went into the development and production of the missiles. DOD officials decided, however, not to release the Poseidon missiles to Lockheed for commercialization until after the signing and ratification of the Strategic Arms Reduction Treaty (START) between the United States and the Soviet Union. In addition, the FY1991 Defense Authorization Act (P.L. 101-516) requested that the DOD submit a report to Congress on this issue and requested that the National Space Council address this issue and its impact on the commercial sector before any surplus missile assets were released.

The START treaty was signed on July 31, 1991, but it is not yet ratified. START allows the retention of strategic missiles that become excess to the treaty's limits for the purpose of delivering objects into the upper atmosphere or space. As a result, around 1000 missiles will be available for potential use as launch vehicles in the United States, with an additional 1000 missiles available on the Soviet side. Providing the excess U.S. missile assets for use as launch vehicles could allow the U.S. Government to benefit significantly from a large American taxpayer investment, but it is unclear whether these assets would benefit or hurt the small capacity commercial launch industry and the national interest. Some argue that the United States has already received the maximum worth of the missiles through deterrence and the end of the Cold War, and that the missiles should be destroyed.

Supporters of using the missiles believe such an action could be a catalyst for the development of low-cost launch vehicles and spur development of commercial, small-mission launch services. The modified missiles could provide universities with low-cost access to space for small scientific payloads that could result in a revitalization of small scientific missions. Smaller entrepreneurial companies may be able to enter the launching business with a smaller capital investment by building upon a foundation of surplus assets. Skeptics believe that reusing older strategic missiles that rely on propulsion technology developed 20 to 30 years ago may stifle investment in new, innovative propulsion and related technologies for the next decade. The skeptics also question the cost-effectiveness of missile modification. Although agreeing that the modifications are technically feasible, they believe that the high cost of storing and refurbishing the surplus assets may result in additional costs to the Government. If the assets are to be released, some launch industry officials believe that the release should be subject to strict restrictions.

The National Space Launch Strategy, released by the Space Council in July 1991, states that prior to the release of surplus missiles, the DOD should conduct an assessment of alternative disposition options for the missiles, which will then be reviewed by the Space Council and the National Security Council. DOD is currently conducting this study. The Space Launch Strategy further states that such dispositions will be evaluated in terms consistent with national security and foreign policy interests, available agency resources, defense industrial base considerations, and with due regard to economic impact on the commercial space sector, promoting competition, and the long-term public interest.

"RULES OF THE ROAD" NEGOTIATIONS WITH THE EUROPEANS

The negotiations between the United States and the European Space Agency are proceeding more slowly than anticipated. A main issue appears to be the scope of the negotiations, and until that issue is resolved, it is not clear how much progress will be made on the fundamental issue of what constitutes fair pricing versus unfair government subsidies and policies. Also, although the issue formally is not on the agenda, the question of whether Arianespace should be allowed to bid for launches of U.S. Government satellites seems certain to factor into the discussion.

Much of the action Congress has taken to date in assisting U.S. commercial launch services companies has been to help them compete with Arianespace, but interest essentially has been confined to the Members and committees with jurisdiction over space activities (rather than foreign relations, for example). In the broader congressional milieu, U.S.-European launch competition has been overshadowed by the entry of China and the Soviet Union into the market, but now that the negotiations with ESA have begun, launch competition issues may become intertwined with broader U.S.-European relations.

USE OF SOVIET LAUNCH VEHICLES

Two major issues regarding commercial Soviet launch services are launches from outside the Soviet Union (the Cape York proposal) and launches from within the country. The current political turmoil in the "former Soviet Union" makes it especially difficult to deal with these issues. A significant complexity bridging both issues is with whom agreements would be negotiated--the residual Soviet federal government, governments of individual republics, or other entities. If Russia (where most of the space bureaucracy is located) signs a fair pricing agreement with the United States, for example, does that bind Kazakhstan (where the launch site for geostationary launches is located)? Does the residual Soviet federal government have any authority to sign agreements? Should agreements be signed with individual industrial organizations that build the launch vehicles? These issues affect any attempt to use Soviet launch vehicles, whether the launch is from inside or outside the country.

Cape York

A more fundamental problem faces the Cape York proposal--whether or not it will proceed. The Cape York Space Agency is in financial trouble, and the failure of the last two Zenit launches will certainly complicate Australian government efforts to find other investors. The lack of a version of the Zenit capable of placing satellites in geostationary orbit is another obstacle.

If the Australians do go forward in some manner with Cape York, there still will be many hurdles to be overcome. USBI was granted an export license to provide technical assistance to CYSA on the condition that it negotiate agreements with CYSA, the Australian government and the Soviet government to ensure that the Soviets provide launch services from only one launch site outside the Soviet Union and forgo commercial launches of Western satellites from inside the Soviet Union; the Soviet Union and Australia abide by the international agreement controlling the export of ballistic missile technology (the Missile Technology Control Regime--MTCR); and all parties observe U.S. laws on transfer of military significant technology to the Soviets. If USBI wants to proceed to the next phase of the Cape York proposal--construction or operation of the Cape York facility--it would have to reach additional agreement that CYSA would abide by fair market practices in the pricing of launch services.

Questions arise as to how these agreements are to be negotiated and how flexible the U.S. Government may be, for example, if the Soviets refuse to accept one condition but agree to the others. For example, the Soviets have agreed to abide by the MTCR (though it is not clear whether they interpret it in the same manner as the United States), but refuse to forgo commercial launches from inside the Soviet Union. There is the further question of how such an agreement would be enforced. As discussed below, some argue that China is not abiding by its agreement with the United States, and the same problem could develop with the Soviet Union. Would specific sanctions be outlined as to what actions the United States would take if the Soviets failed to live up to the agreement?

Launches from Within the Soviet Union

The issues involving launch of U.S. satellites on Soviet vehicles from within the Soviet Union may take on more importance in the wake of the August 1991 coup attempt. If conditions continue to improve between the United States and the residual Soviet federal government and the republics, and if agreement can be reached with the responsible authorities to abide by fair pricing agreements, the United States may temper its objections to Soviet commercial launches. In fact, some have suggested that the United States use the purchase of Soviet space products and services (including launch services) as an avenue for financially supporting the new government. The United States might also leverage the issue to achieve other political goals with the central government or the republics.

Many argue that U.S. concerns about technology transfer from exporting satellites to the Soviet Union are highly overstated, since most of the communications satellite technology involved is well known. In any case, it seems unlikely that the Soviets could learn a great deal by examining the satellites non-invasively (with X-rays, for example), and if they took the satellite apart, the likelihood of successfully reassembling it is extremely slim. The fact that the Soviet government agreed to waive customs inspections and allow the satellite owner to remain with the satellite throughout its time in the Soviet Union also mitigates against them acquiring technology from such an arrangement. Thus, to many observers it appears that the primary U.S. interest in preventing the Soviets from launching U.S.-built satellites is economic competitiveness.

How U.S. policy might change in the post-coup environment is unclear. While some might want to loosen U.S. restrictions on exporting satellites to the Soviet Union or the republics as a way of financially supporting the new democracies, others undoubtedly would oppose any action that might increase competition for U.S. firms.

CHINA'S COMMERCIAL SPACE LAUNCH BUSINESS

At least two questions arise with regard to China. The first concerns overall U.S.-Chinese relations and whether the United States should permit exports to China if they do not improve their human rights and ballistic missile proliferation policies. Overall Chinese government politics are outside the purview of this report, but they could have a strong bearing on whether the President or Congress will approve export licenses for satellites bound for China. Language passed by the 101st Congress outlined steps Congress wanted China to take to improve human rights, for example, but also permitted the President to decide that launches of U.S.-built satellites on Chinese launch vehicles were "in the national interest" despite the political situation. Hence, Asiasat was exported to China and launched, the AUSSAT licenses were renewed, and components for Sweden's Freja satellite were approved for export. However, the Administration's refusal to export components for a communications satellite China planned to build because of concerns about Chinese missile proliferation policies, and the President's later statement that no more satellite export licenses would be approved until those policies change, indicates Administration willingness to use space-related export requests as leverage on the Chinese government at least in some cases.

The second question concerns China's adherence to the 1989 agreement. According to the Chinese, they *are* abiding by the terms of the agreement by offering prices that fairly reflect their costs. Others feel the price China offered for the Arabsat launch was far below what other service providers would offer. The major issue is whether China is, in fact, violating the agreement, which requires China to price its services "on a par" with other launch service providers. Since "on a par" is not further defined, it is open to interpretation. Ultimately, the question is what can the United States do if it finds China not in compliance with the agreement. Would it impose sanctions? Would it deny

future export licenses? Would it again suspend the export licenses for AUSSAT 1 and 2?

JAPAN AS A POTENTIAL COMPETITOR

Japan is not discussed extensively in this paper because it does not currently offer commercial launch services. The H-1 launch vehicle now used by the National Space Development Agency (NASDA) incorporates U.S. technology, and under the agreement that gives NASDA access to that technology, Japan may not provide launch services to third parties without U.S. permission. (The Mu launch vehicle used by the Institute for Space and Aeronautical Sciences, ISAS, is completely Japanese, but it is not offered commercially.) The Japanese are now developing the H-2 rocket which will be all-Japanese, raising the issue of whether Japan will enter the commercial market once it is operational. Originally scheduled to enter service in 1992, the H-2 program has been delayed because of technical problems, but the Japanese hope to conduct the first launch in 1993.



Whether Japan becomes a competitor may depend on how much of a market there is for launch services and how Japan would get a foothold in a field already full of suppliers. Since Japan is currently limited to only two flights per year from each of its two launch sites¹⁶⁶ because of government agreements with the fisherman who work the nearby waters, many expect that Japan would have to find another launch site if it wanted to enter the business in any but a symbolic way. Japan has been talking for years about the possibility of a joint U.S./Japanese spaceport in Hawaii, and there also is speculation that Japan may launch from Cape York, Australia if that project proceeds. Whether Japan would consider it worthwhile to finance a new launch site for only a small piece of market remains to be seen.

Seventy-seven Japanese aerospace corporations, insurance companies and banks created a new company, Rocket Systems, Inc., in 1990 to build the H-2

¹⁶⁶ NASDA launches from Tanegashima (31°N, 130°E), while ISAS launches from Uchinoura (32°N, 130°E).

launch vehicle.¹⁵⁶ Japanese officials stated that the primary motivation behind the formation of the company was not to enter the commercial launch market, but to reduce launch vehicle costs for NASDA and spread financial risk.¹⁵⁷ NASDA is not allowed to make multi-year commitments to purchase several launch vehicles at a time, so existing launch vehicles are built one at a time. Rocket Systems, Inc., conversely, will be able to build a block of launch vehicles, thereby reducing costs. NASDA will purchase the vehicles it needs from Rocket Systems. Officials involved in the creation of the company assert that no decision has been made whether to offer launches on the commercial market.¹⁵⁸ Koji Sato, a manager at Mitsubishi, has been quoted as saying that "If everything goes well, we would like to be like Europe's Arianespace, but that is only a dream now," and that commercial operations would not be possible until the late 1990s.¹⁵⁹

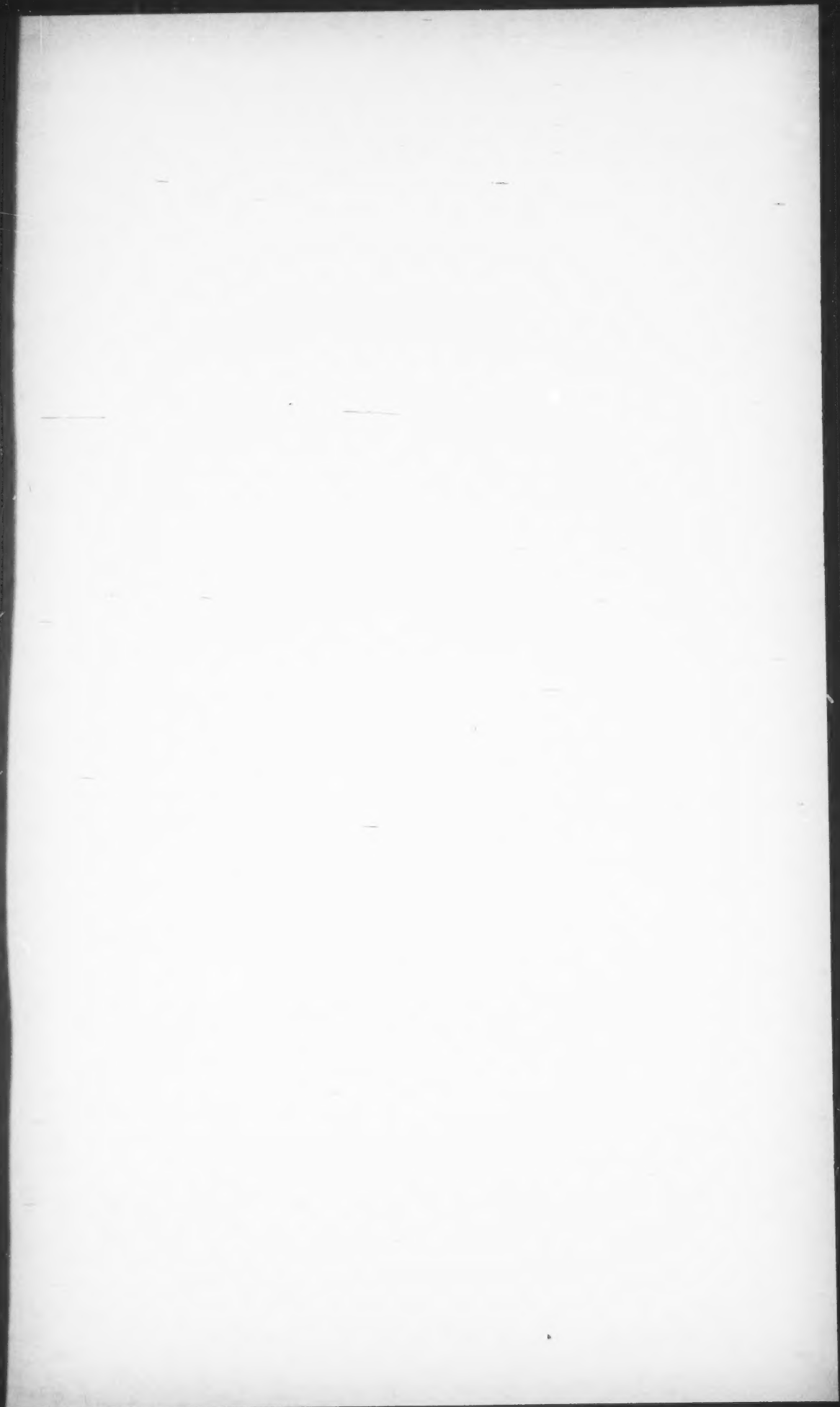
Thus, while there is much speculation about Japan becoming a competitor in the launch services market, it does not appear that Japan is ready to make such a decision today. Undoubtedly, however, the specter of Japanese competition will continue to worry existing launch services companies.

¹⁵⁶ The primary corporate sponsors are Mitsubishi, IHI, Kawasaki Heavy Industries, Nissan Motor Corp., Nippon Electric Co., Toshiba Corp., Japan Aviation Electronics Industry, Ltd., and Fujitsu Corp. Mitsubishi Leads Privatization Effort as First H-2 Boosters are Fabricated. *Aviation Week and Space Technology*, Aug. 13, 1990. p. 62.

¹⁵⁷ *Ibid.*, p. 64.

¹⁵⁸ Lawler, Andrew. New Consortium to Position Japan for Launch Vehicle Sales. *Space News*, May 28-June 3, 1990. p. 1.

¹⁵⁹ Mitsubishi Leads Privatization Effort as First H-2 Boosters are Fabricated. *Aviation Week and Space Technology*, Aug. 13, 1990. p. 64.

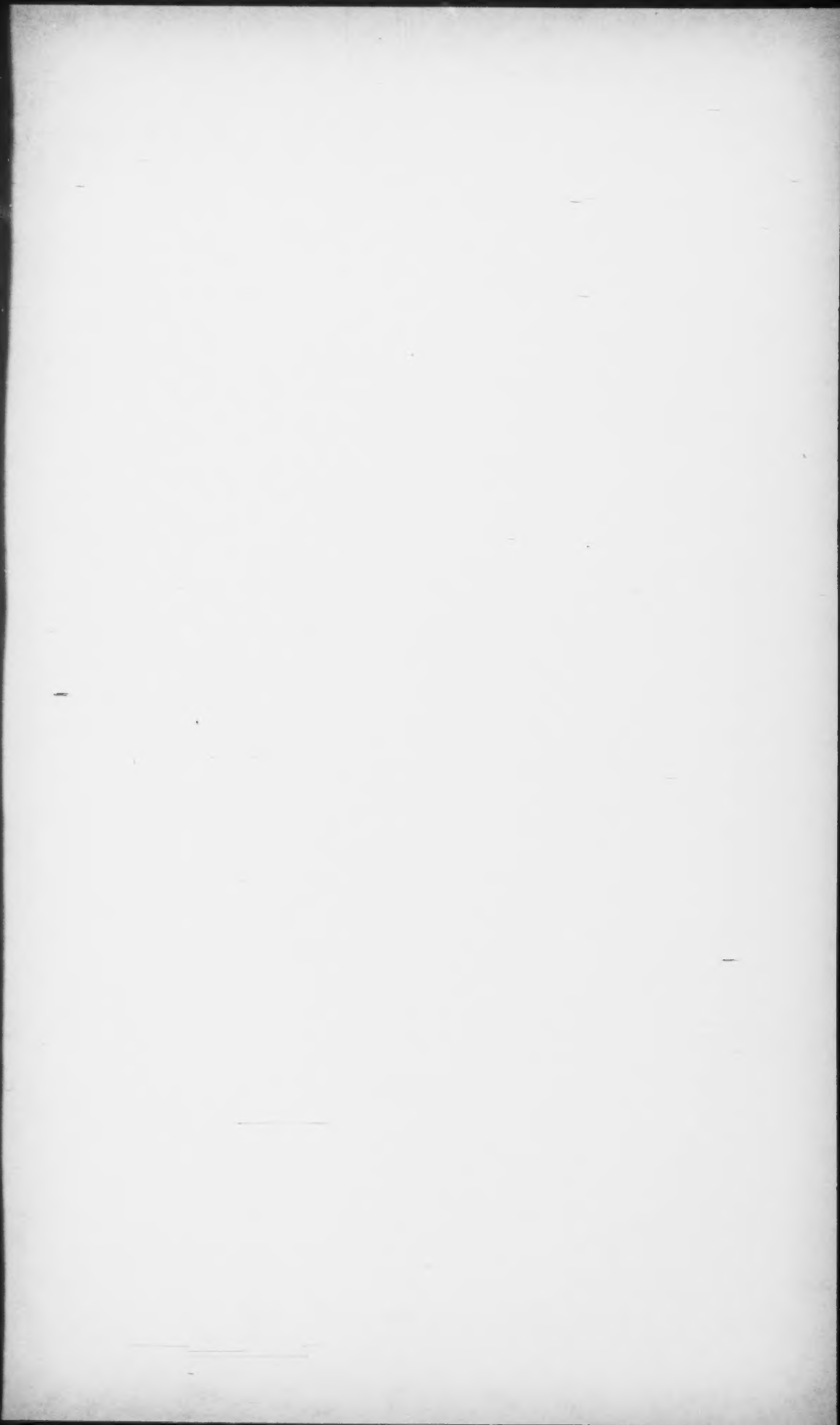


APPENDIXES



APPENDIX 1

COMMERCIAL SPACE LAUNCH POLICY



THE WHITE HOUSE

Office of the Press Secretary

For Immediate Release

September 5, 1990

STATEMENT BY THE PRESS SECRETARY

The President has approved a new National Space Policy Directive providing important guidance which will further encourage the growth of U.S. private sector space activities. This policy, developed by the Vice President and the National Space Council, is completely consistent with, and provided the policy framework for, the President's August 22, 1990, decision regarding participation by a U.S. firm in Australia's Cape York space launch project. The policy supplements the National Space Policy which the President approved on November 2, 1989.

The commercial space launch policy recognizes the many benefits which a commercial space launch industry provides to the United States. It balances launch industry needs with those of other industries and with important national security interests, and establishes the long term goal of a free and fair market in which U.S. industry can compete. The policy specifies a coordinated set of actions for the next ten years aimed at achieving this goal.

Attachment

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Office of the Press Secretary

For Immediate Release

September 5, 1990

FACT SHEET

COMMERCIAL SPACE LAUNCH POLICY

POLICY FINDINGS

A commercial space launch industry can provide many benefits to the U.S. including indirect benefits to U.S. national security.

The long term goal of the United States is a free and fair market in which U.S. industry can compete. To achieve this, a set of coordinated actions is needed for dealing with international competition in launch goods and services in a manner that is consistent with our non-proliferation and technology transfer objectives. These actions must address both the short term (actions which will affect competitiveness over approximately the next ten years) and those which will have their principal effect in the longer term (i.e. after approximately the year 2000).

- In the near term, this includes trade agreements and enforcement of those agreements to limit unfair competition. It also includes the continued use of U.S. manufactured launch vehicles for launching U.S. Government satellites.

- For the longer term, the United States should take actions to encourage technical improvements to reduce the cost and increase the reliability of U.S. space launch vehicles.

IMPLEMENTING ACTIONS

U.S. government satellites will be launched on U.S. manufactured launch vehicles unless specifically exempted by the President.

Consistent with guidelines to be developed by the National Space Council, U.S. Government Agencies will actively consider commercial space launch needs and factor them into their decisions on improvements in launch infrastructure and launch vehicles aimed at reducing cost, and increasing responsiveness and reliability of space launch vehicles.

The U.S. Government will enter into negotiations to achieve agreement with the European Space Agency (ESA), ESA member states, and others as appropriate, which defines principles of free and fair trade.

Non-market launch providers of space launch goods and services create a special case because of the absence of market-oriented pricing and cost structures. To deal with their entry into the market there needs to be a transition period during which special conditions may be required.

There also must be an effective means of enforcing international agreements related to space launch goods and services.

COMMERCIAL SPACE LAUNCH POLICY

POLICY FINDINGS

A commercial space launch industry can provide many benefits to the U.S. including indirect benefits to U.S. national security.

The long term goal of the United States is a free and fair market in which U.S. industry can compete. To achieve this, a set of coordinated actions is needed for dealing with international competition in launch goods and services in a manner that is consistent with our non-proliferation and technology transfer objectives. These actions must address both the short term (actions which will affect competitiveness over approximately the next ten years) and those which will have their principal effect in the longer term (i.e. after approximately the year 2000).

- In the near term, this includes trade agreements and enforcement of those agreements to limit unfair competition. It also includes the continued use of U.S. manufactured launch vehicles for launching U.S. Government satellites.
- For the longer term, the United States should take actions to encourage technical improvements to reduce the cost and increase the reliability of U.S. space launch vehicles.

IMPLEMENTING ACTIONS

U.S. government satellites will be launched on U.S. manufactured launch vehicles unless specifically exempted by the President.

Consistent with guidelines to be developed by the National Space Council, U.S. Government Agencies will actively consider commercial space launch needs and factor them into their decisions on improvements in launch infrastructure and launch vehicles aimed at reducing cost, and increasing responsiveness and reliability of space launch vehicles.

The U.S. Government will enter into negotiations to achieve agreement with the European Space Agency (ESA), ESA member states, and others as appropriate, which defines principles of free and fair trade.

Non-market launch providers of space launch goods and services create a special case because of the absence of market-oriented pricing and cost structures. To deal with their entry into the market there needs to be a transition period during which special conditions may be required.

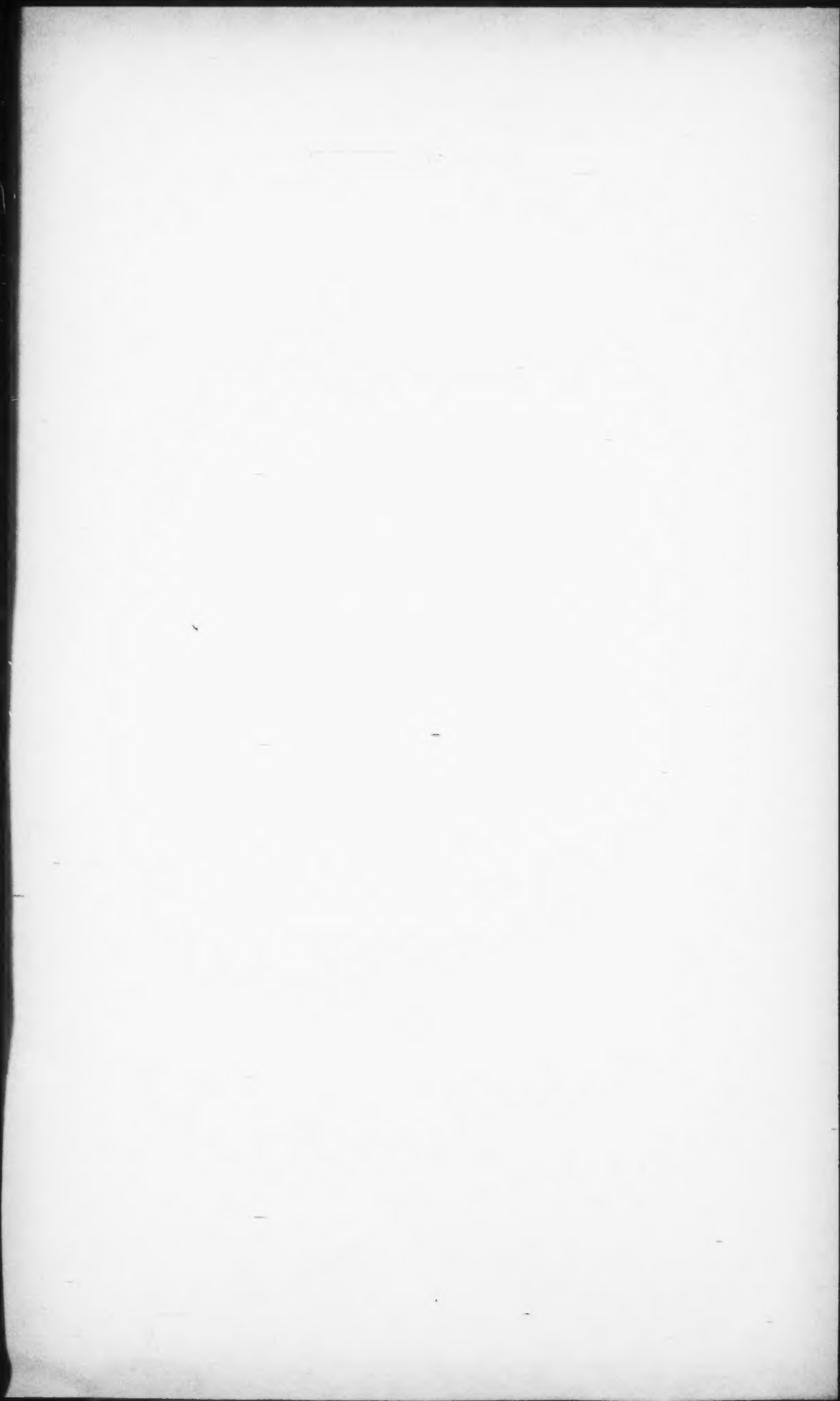
- There should be no change in the U.S. Government's longstanding policy to deny, except in extraordinary circumstances, exports of satellites and satellite

components to the Soviet Union.

- The United States will seek to limit the use of Soviet launch vehicles, launch equipment, technology or training to a single mutually agreed upon location outside the Soviet Union. The USSR would thereby agree to forego commercial launches of Western satellites from the Soviet Union. In addition to technology transfer safeguards, U.S. support for such use of Soviet manufactured launch vehicles will be contingent on enforceable agreements related to free and fair trade and to ballistic missile non-proliferation.

- The United States will also seek agreement that launch services offered commercially will be in compliance with a common approach for the entry of non-market economy countries as negotiated by the U.S. Government with foreign launch providers, as appropriate.

There also must be an effective means of enforcing international agreements related to space launch goods and services.



APPENDIX 2

COMMERCIAL LAUNCH LICENSES ISSUED

<u>LAUNCH COMPANY</u>	<u>LICENSE</u>	<u>DATE ISSUED</u>
1. Conatec, Inc.	88-001	Jun 22, 1988
2. McDonnell Douglas Corp.	88-003	Jun 23, 1988
3. Space Services, Inc.	89-004	Mar 08, 1989
4. McDonnell Douglas Corp.	89-005	May 05, 1989
5. American Rocket Corp.	89-006	Jul 07, 1989
6. Martin Marietta Commercial Titan, Inc.	89-007	Jul 18, 1989
7. Space Services, Inc.	89-008	Oct 04, 1989
8. McDonnell Douglas Corp.	89-009	Dec 05, 1989
9. McDonnell Douglas Corp.	89-010	Dec 11, 1989
10. McDonnell Douglas Corp.	89-011	Dec 11, 1989
11. McDonnell Douglas Corp.	90-012	Jan 19, 1990
12. Martin Marietta Commercial Titan, Inc.	90-013	Feb 15, 1990
13. Martin Marietta Commercial Titan, Inc.	90-014	Apr 24, 1990
14. McDonnell Douglas Corp.	90-015	May 10, 1990
15. McDonnell Douglas Corp.	90-016	Jun 01, 1990
16. General Dynamics Commercial Launch Services, Inc.	90-017	May 17, 1990
17. Orbital Sciences Corp. Space Data Div.	90-018	Dec 21, 1990
18. General Dynamics Commercial Launch Services, Inc.	LLO-91-019	Feb 20, 1991
19. Orbital Sciences Corp. Space Data Div.	LLO-91-020	Mar 27, 1991
20. McDonnell Douglas Corp.	91-023	Mar 13, 1991
21. McDonnell Douglas Corp.	LLO-91-023	May 01, 1991
22. Orbital Sciences Corp.	LLL-91-025	May 23, 1991

Prepared by CRS.

Source: Office of Commercial Space Transportation, DOT.



APPENDIX 3

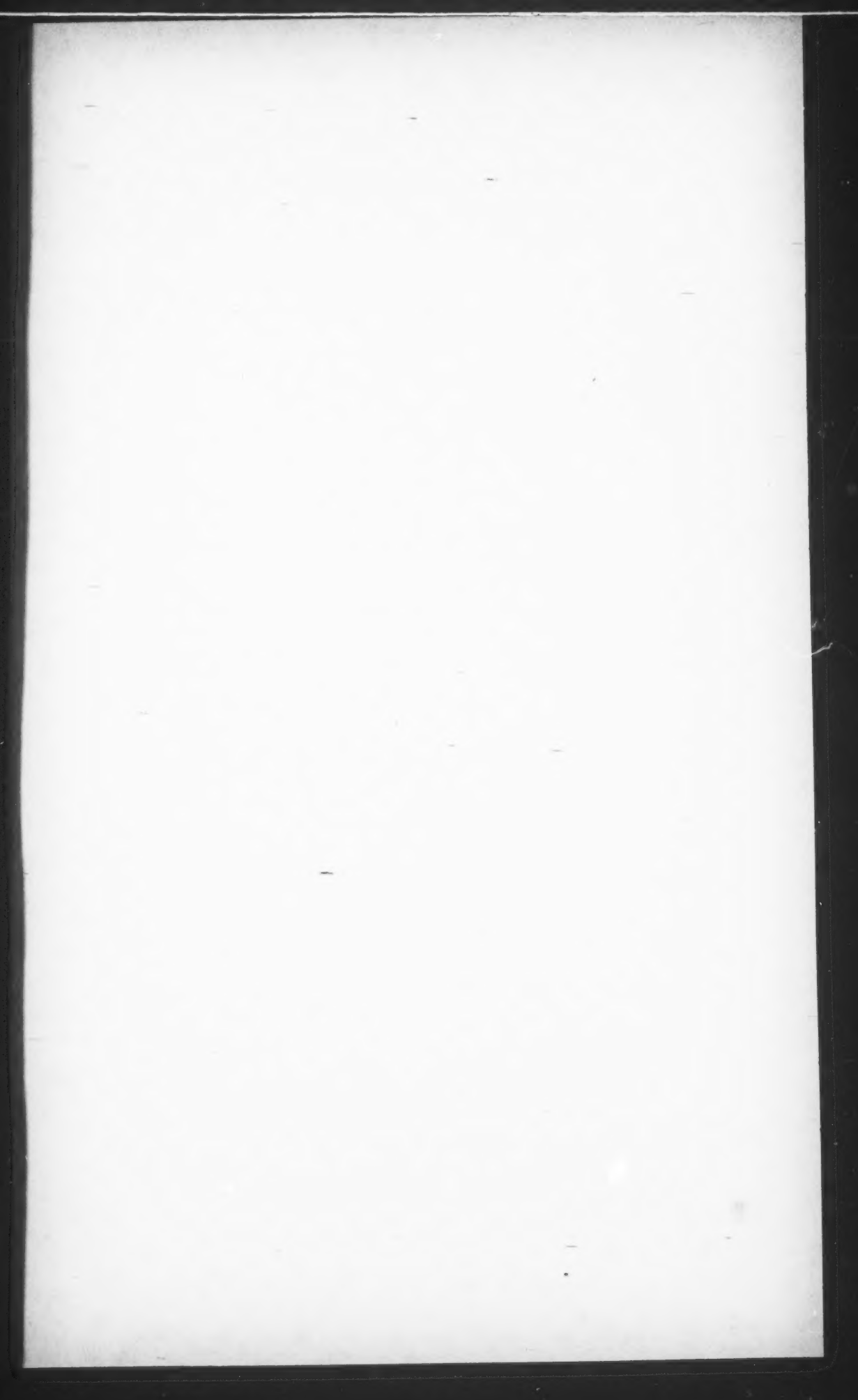
LICENSED COMMERCIAL LAUNCHES

	<u>LICENSE</u>	<u>VEHICLE</u>	<u>PAYLOAD</u>	<u>DATE</u>
1.	89-004	Starfire	CONSORT-1*	Mar 03, 1989
2.	89-005	Delta 4925	BSB-R1	Aug 27, 1989
3.	89-006	AMROC (SMLV)	SET-1	Oct 05, 1989(f)
4.	89-008	Starfire 1	CONSORT-2*	Nov 15, 1989(f)
5.	89-007	Comm. Titan	JCSAT/SKYNET	Dec 31, 1989
6.	90-012	Delta 6920-8	LOSAT	Feb 14, 1990
7.	90-013	Comm. Titan	INTELSAT VI	Mar 14, 1990(f)
8.	89-009	Delta 6925-8	PALAPA B2-R	Apr 13, 1990
9.	89-008	Starfire 1	CONSORT-3*	May 17, 1990
10.	90-015	Delta 4925	INSAT-1D	Jun 12, 1990
11.	90-014	Comm. Titan	INTELSAT VI	Jun 23, 1990
12.	90-017	Atlas I	CRRESS	Jul 25, 1990
13.	90-016	Delta II 6925	BSB-R2	Aug 17, 1990
14.	89-010	Delta II 6925	INMARSAT 2 FLT 1	Oct 30, 1990
15.	89-011	Delta II 7925	NATO IVA	Jan 07, 1991
16.	89-010	Delta II 6925	INMARSAT 2 FLT 2	Mar 08, 1991
17.	91-021	Delta II 7925	ASC-2	Apr 12, 1991
18.	LLO-91-019	Atlas I	BS-3H	Apr 18, 1991(f)
19.	LLO-91-023	Delta II 7925	AURORA II	May 29, 1991
20.	90-018	Prospector	JOUST-1*	Jun 18, 1991(f)
21.	LLS-91-026	Talos Castor 1	ZEST-1*	Sep 02, 1991
22.	LLS-91-026	Talos Castor 1	ZEST-2*	Sep 11, 1991

Note: * Suborbital launch.
 (f) Launch was a failure.

Prepared by CRS.

Source: Office of Commercial Space Transportation, DOT.



APPENDIX 4

ARIANESPACE SHAREHOLDERS

<u>COUNTRY/ORGANIZATION</u>	<u>PERCENT</u>
BELGIUM	4.33
Etudes Techniques et Constructions	1.43
Aerospatiales (ETCA)	
FN MOTEURS SA	0.30
Ste Anonyme Belge de Constructions	2.60
Aeronautiques (SABCA)	
DENMARK	0.67
ALCATEL KIRK A/S	0.48
COPENHAGEN HANDELSBANK	0.19
FRANCE	56.65
AEROSPATIALE	7.80
AIR LIQUIDE	1.76
Centre National d'Etudes Spatiales (CNES)	32.34
CEGELEC	0.10
COMPAGNIE DEUTSCHE	0.10
INTERTECHNIQUE	0.10
MATRA ESPACE	3.26
SAFT	0.10
SEXTANT AVIONIQUE	0.19
SOCIETE EUROPEENNE DE PROPULSION (SEP)	7.80
SFIM	0.10
Ste Nle des Poudres et Explosifs (SNPE)	1.00
THOMSON CSF	0.10
Societe Financiere Auxiliaire (BNP)	0.47
CREDIT LYONNAIS	0.47
OPFI PARIBAS	0.38
GENEVAL SA (Societe Generale)	0.38
BANQUE SAN PAOLO	0.19
Diverses Personnes Physiques	0.01
GERMANY	18.65
DORNIER GmbH	2.66
ERNO Raumfahrttechnik GmbH	4.95
MAN TECHNOLOGIE AG	7.51
Messerschmitt Bolkow Blohm (MBB)	2.66
DRESDNER BANK Aktiengesellschaft	0.29
BAYERISCHE VEREINSBANK	0.29
WESTDEUTSCHE LANDESBANK GIROZENTRALLE	0.29
IRELAND	0.24
ADTEC TEORANTA	0.14
AER LINGUS TEORANTA	0.10

ARIANESPACE SHAREHOLDERS
(continued)

<u>COUNTRY/ORGANIZATION</u>	<u>PERCENT</u>
ITALY	7.12
AERITALIA	1.05
SELENIA SPAZIO	0.76
BDP DIFESA E SPAZIO	4.53
FERRANTI INDUSTRIE SPAZIO E COMUNICAZIONI SpA	0.28
FIAT AVIAZIONE SpA	0.50
NETHERLANDS	2.09
FOKKER SPACE AND SYSTEMS BV	1.80
ALGEMENE BANK NEDERLAND NV	0.29
SPAIN	2.38
Constructiones Aeronauticas SA (CASA)	1.81
SENER	0.57
SWEDEN	2.28
SAAB SPACE AB	0.76
VOLVO FLYGMOTOR AB	1.52
SWITZERLAND	2.57
Compagnie Industrielle Radio-Electrique (C.I.R.)	0.14
CONTRAVES AG	2.04
Fabrique Federale d'Avions (F + W)	0.10
UNION DE BANQUES SUISSES	0.29
UNITED KINGDOM	3.02
MEGGIT (U.K.) LTD	0.13
BRITISH AEROSPACE PLC	1.90
GEC FERRANTI DEFENCE SYSTEMS LTD	0.90
MIDLAND BANK PLC	0.09

Source: Arianespace Annual Report, 1989.

APPENDIX 5

NUMBER OF SATELLITES BOOKED FOR ORBITAL COMMERCIAL LAUNCHES AFTER SEPTEMBER 2, 1991

Company/Country	Launch Vehicle	Number of Satellites
EER Systems	Conestoga	3
Orbital Sciences	Pegasus	2
McDonnell Douglas	Delta	3
General Dynamics	Atlas	21
Martin Marietta	Titan	0
Arianespace	Ariane	34
China Great	Long March 2E	2
Wall Industry Corp.	Long March 2	1
Soviet Union	Vostok	1
(Licensintorg)	Not specified	1*
	Proton	2-8**

* For the Indian communications satellite, Gramsat.

** For launches of secondary payloads.

Prepared by CRS from press reports and information from companies offering launch services.



APPENDIX 6

SAMPLE MODEL RANGE USE AGREEMENT



(SAMPLE MODEL AGREEMENT)

DEPARTMENT OF THE AIR FORCE
COMMERCIALIZATION AGREEMENT

3-31-88

CHANGED 3 MAY 1989

ARTICLE I - INTRODUCTION

a. This Agreement (hereinafter the "Agreement") is entered into between the United States Air Force (hereinafter referred to as the "Air Force" or the "Government") and _____ Corporation (hereinafter referred to as the "User"). This agreement is made pursuant to the authority of the Commercial Space Launch Act of 1984, 49 U.S.C. 2601-23, and the Military Leasing Act, 10 U.S.C. 2667. It is not subject to the provisions of the Federal Acquisition Regulations (FAR), except insofar as particular FAR provisions are specifically stated to be made applicable. Unless specifically stated to the contrary, all references to the Government throughout this agreement shall mean the U.S. Air Force or its appropriate element(s). This Agreement sets forth the terms and the conditions under which the Air Force will furnish real property, facilities goods and services to the User in support of production and/or launching of commercial expendable launch vehicles ("ELV's") on a cost-reimbursable basis.

b. This Agreement is made pursuant to and in conformity with Attachment 1 the Statement of Real Property, Facilities, Goods and Services dated 25 Feb 88 (hereinafter referred to as the Statement), which sets forth the real property, facilities, goods and services to be provided by the Government in support of production and/or launching of commercial ELVs.

c. In the event of an inconsistency, unless otherwise expressly provided herein, such inconsistency shall be resolved by giving precedence in the following order:

1. Articles I through XIX of this Agreement;
2. Attachment 1, Statement of Goods and Services; and
3. Annexes A, B, and C of this Agreement.

ARTICLE II - GOVERNMENT ACTIONS

1. The government will make all reasonable efforts to minimize adverse impacts its actions may have on commercial operations and accord commercial users a high degree of stability in conducting their commercial launch business.

2. Whenever in this Agreement the doing of an act or the exercise of any right by the User is conditioned upon receipt of approval, permission, agreement, authorization, or any other form of cooperation or acquiescence by the Government, the Government shall promptly render its decision and shall neither unreasonably withhold nor unreasonably condition its approval of a request by the User. In all its actions relative to the maintenance, operation, development, and management of the range, the Government will conduct itself in a reasonable and prudent manner.

ARTICLE III - DEFINITIONS

Agency. An executive agency of the Government as defined by section 105 of title 5, United States Code.

Centers. Eastern Space and Missile Center (ESMC), Patrick AFB, FL and Western Space and Missile Center (WSMC), Vandenberg AFB, CA.

Contracting Officer. (including "ACO" or "PCO"). Means the duly authorized representative of the Eastern Space and Missile Center Commander or the Western Space and Missile Center Commander, as appropriate.

Direct Cost. Cost identified as such in Department of Defense Directives (DoDD's) 3230.3 and 3200.11.

Facility. Property used for production, maintenance, research, development, or testing. It includes plant equipment and real property, but not material, special test equipment, or special tooling.

Government Property. All property, real or personal, that is owned or leased by the Government. It consists of materials, special tooling, special test equipment, military property, facilities, and software.

Launch. To place or attempt to place a launch vehicle and payload, if any, in any sub-orbital trajectory, in Earth orbit in outer space, or otherwise in outer space.

Launch Property. Propellants, launch vehicles and components thereof, and other physical items constructed for or used in the launch preparation or launch of a launch vehicle.

Launch Services. Those activities involved in the preparation of a launch vehicle and its payload for launch and the conduct of a launch.

Launch Site. The location of earth from which a launch takes place, including all facilities located on a launch site which are necessary to conduct a launch.

Launch Vehicle. Any vehicle constructed for the purpose of operating in, or placing a payload in outer space, and any sub-orbital rocket.

Liability. To include, but not be limited to, legal obligations pursuant to any Government treaty, any judgment by a court of competent jurisdiction, administrative and litigation costs, and settlement payments. To include such legal obligations that are the result of any environmental incident as further defined in the applicable Annex, Part IV.F.

Payload. An object which a person undertakes to launch into space or place in Earth orbit by means of a launch vehicle, including subcomponents of the launch vehicle specifically designed or adapted for that object.

Person. Any individual and any corporation, partnership, joint venture, association, or other entity organized or existing under the laws of any State or any nation.

Production and Research Property. Government-owned ELV production and research equipment and facilities, including special test equipment, and special tooling to which Government has title or the right to acquire title.

State and United States. When used in a geographical sense, mean the several States, the District of Columbia, the Commonwealth of Puerto Rico, American Samoa, the United States Virgin Islands, Guam, and any other commonwealth, territory, or possession of the United States.

Subcontractor. Supplier at any tier or any vendor.

United States Citizen.

(A) Any individual who is a citizen of the United States;

(B) Any corporation, partnership, joint venture, association, or other entity organized or existing under the laws of the United States or any State; and

(C) Any corporation, partnership, joint venture, association, or other entity which is organized or exists under the laws of a foreign nation, if the controlling interest (as defined by the Secretary of Transportation in regulations) in such entity is held by an individual or entity described in subparagraph (A) or (B) above.

ARTICLE IV - ALLOCATION OF RISKS

a. This article allocates the responsibility for paying for damages to Government property or for tort claims arising out of the commercial use of launch services, facilities, and equipment to be provided to Users by the Government and its contractors and subcontractors under this Agreement. To the extent that the financial responsibility for a risk of damage or liability is not settled by the terms of this Agreement, U.S. law shall govern the allocation of such responsibility between the User and the Government.

b. Definitions

For purposes of this Article.

1. "Damage" shall mean bodily injury or death of any person, damage to or loss of any property, real or personal, and loss of revenue or profits or other direct, indirect, or consequential damages therefrom. Such "Damage" shall include that caused by a release of or exposure to a hazardous substance, as that term is defined in Section 101(a) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 U.S.C. 9601, as amended by the Superfund Amendments and Re-authorization Act of 1986, and referenced authorities therein, or as the term may be further defined by future Federal legislation.

2. "Third-party liability" shall mean the legal liability of a party to this Agreement for damage to all persons or parties not signatory parties hereto. This includes the private claims for personal injury or death or damage to private property by contractors or subcontractors of either party, or by the employees or any of the above, or by US military personnel. It also includes civil liability for costs, fines, penalties, etc., imposed as a result of enforcement actions or other administrative or civil judicial actions for violation of Federal, State, or local laws, e.g., environmental laws, in the conduct of activities under this Agreement.

3. "Maximum available insurance" shall mean the amount of insurance available in the world market at a reasonable premium and on terms considered commercially reasonable for the risks involved to fund the User's responsibilities under this Agreement, or a specified provision of this Agreement.

4. "Launch" means, in addition to the definition in Article III, all activities in preparation for a launch, the act of launching itself, occurrences in the atmosphere, in space, or on Earth after descending from the atmosphere of space, and activities after the launch to clean up and refurbish Government or User property and to remove it from the launch site and any other Government or User facility.

c. Liability, Responsibility for Paying Claims, and Insurance

1. User shall assume the responsibility of paying for all damage to property of the User, the Government, or their contractors and subcontractors, and all third-party liability, arising out of this agreement, regardless of fault, to the extent of the maximum available insurance for the specific launch except that the User shall not be responsible for damage caused by the intentional misconduct of the Government and the Government's contractors and subcontractors.

2. To fully assume the third-party liability stated above, the User shall indemnify and hold harmless the Government, its contractors, and subcontractors, and the agents, servants, employees and military personnel of each of them, including paying their attorney's fees, from any third-party liability arising out of activities under this Agreement. These include, but are not limited to, the production of launch vehicles and associated equipment or facilities, marketing of launch services, use of Government services or facilities, launch operations, use of space flight vehicles or their payloads in flight or in space, damage caused by its space objects upon the Earth or to aircraft in flight, and environmental incidents or legal violations.

3. To the extent that Government damages and/or third-party claims which arise in connection with a specific launch are in excess of the amount of the maximum available insurance for that launch, questions of liability between parties and responsibility for paying claims will be left for resolution according to the applicable law of the U.S. (e.g., tort law, the Federal Tort Claims Act).

4. The User's liability and responsibility to pay claims assumed above and covered by its indemnification and hold harmless commitments shall be covered, up to the maximum available insurance, commercially available at a reasonable price, by an appropriate insurance policy or policies procured by the User. The maximum available insurance for a specific launch or particular associated activities shall be determined by the Government. Its decision on the issue shall be final and not subject to Article IX, Disputes. The User shall provide to the Government a copy of the executed insurance policy or policies required under this Article, or other evidence satisfactory to the Government, within a reasonable time before commencement of each of the commercial launch activities to which the insurance relates. The terms of all such insurance must be acceptable to the Government. The Government shall be named insured under all such policies, and the policies shall renounce any right of subrogation against the Government. Such insurance shall be kept in effect throughout the activity or period of time to which the insurance relates. The User shall provide the Government with written notice at least 30 calendar days prior to cancellation or material change in policy coverage, and shall promptly provide the Government with copies of other policy modifications as they occur.

5. The extent of the User's liability or responsibility for paying claims, up to the amount of maximum available insurance, shall not be reduced by amounts:

- (a) which are within the deductible amounts of the User's insurance policies; or
- (b) which are not covered by the insurance because of an exclusion or other policy limitation, except for the maximum dollar limit stated in the policy, provided that this subparagraph shall not apply to policy exclusions or limitations which are reasonably determined by the Air Force to be usual for the type of insurance involved, and consistent with the User's obligation to obtain the maximum amount of insurance commercially available at reasonable premiums and on terms considered commercially reasonable for the risks involved; or
- (c) of payments to its clients, contractors, or subcontractors for a liability incurred to that client, contractor, or subcontractor; or
- (d) of settlement payments, unless such settlements are agreed to by the Government.

6. The User's insurance and assumption of liability to the Government hereunder shall not be exclusive recourse of the United States in the event that the Government is for any reason unable to recover for such liability and damage from the insurance provider or the User. The United States reserves the right to pursue claims or bring appropriate legal action against the User or any other responsible party for its damage or for liability incurred under U.S. or international law or agreement.

7. The Government agrees to cooperate with the User in obtaining any information, data, reports, contracts, and similar materials in connection with the presentation of any claim by the User under any policy of insurance provided pursuant to the requirements of this Article.

8. The User shall be subject to established or general Government liability insurance requirements with respect to access to and use of Government or Government contractor property, to the extent not expressly and specifically addressed in this Agreement. These include, but are not limited to, providing and maintaining insurance, at no cost to the government, of at least the types and in the amounts set forth below:

- (a) Worker's Compensation - \$100,000,
- (b) Employer's Liability - \$100,000,
- (c) Comprehensive Automobile Liability - In accordance with general installation regulations;
and
- (d) Insurance required by Federal, State, or local environmental protection laws and regulations.

9. The User shall:

- (a) promptly notify the Government of any claim or action against, or any loss by, the User or any contractors/subcontractors or their parties in privity of contract therewith;
- (b) immediately furnish to the Government copies of all pertinent papers the User receives regarding any such claim or action.

d. Government Property

1. All government property is to be furnished "as is," the Government makes no warranty, express or implied, whatsoever, regarding its property.

2. The User may inspect Government property prior to use. Such property may be repaired or modified at the User's expense only after obtaining the written permission of the Government. Any repair or modification of such property shall not affect the title of the Government. The User shall at no expense to the Government, return any modified property to the condition in which it was received, unless the Government agrees otherwise.

e. Patent Infringement Claims

1. The User agrees to reimburse the Government for any cost incurred by the Government as a result of an unlicensed use (infringement) of privately owned U.S. patents to the extent that any such costs are attributable to products, processes, or articles of manufacture actually used by the Government in connection with the furnishing of services to the User under provisions of this Agreement. Such costs shall include, but are not limited to, administrative and litigation costs, and settlement payments made by the Government as a result of administrative consideration of claims against the Government for infringement of such patents, as well as costs incurred by the Government in the form of a judgment against the Government by a court of competent jurisdiction.

2. If the User is licensed under a privately owned third party patent, and to the extent that the launch and associated services furnished by the Government under this Agreement constitutes a licensed use under the User's license and is not covered by a Government license, any compensation for such use shall be handled directly by the User with the third party licensor. In the event it is the decision of either the third party licensor or the User, or both, that such use is not within the scope of the User's license, then the use will be considered unlicensed use and governed by the terms and conditions of this agreement.

3. The reimbursement by the User of costs associated with patent infringement settlements or judgments will be governed solely by this clause. Therefore, except as provided in subparagraph e.1. above, the User shall have no liability to the Government with respect to any third party claim against the Government of patent infringement by the Government in connection with the furnishing of services to the User under the provisions of this Agreement. Further, any costs reimbursable to the Government by the User under the provisions of this agreement shall be reduced pro rata by any amount actually paid to the Government by a third party or to which the Government has a right to payment from a third party as reimbursement or indemnification for any or all of the patent infringement costs of this agreement.

4. The Government will notify the User as promptly as possible of any patent infringement claim asserted against the Government, whether by suit or otherwise, under which the User might be liable for reimbursement of costs. In particular, the Government will notify the User prior to any administrative settlement of a claim under this agreement, and as promptly as possible after the institution of any suit, and preferably before same, based on such a claim. With respect to costs reimbursed by the User under this Agreement, the Government will, promptly after paying any such costs, present the User with a statement itemizing in reasonable detail such costs and identifying the applicable patents associated therewith. Within thirty (30) calendar days after receipt of the Government statement of such costs, the User shall have the right to request a review of its correctness.

5. With respect to any suit against the Government based on a claim of patent infringement, the costs for which the User would be liable under the agreement, the Government disagrees that, subject to law and regulations of the Department of Justice, the User may, at its option, assume a major role in the defense of the suit. The User's right of election to assume a major role in the defense of such a suit shall not in any way affect any other rights otherwise available to it under contract or general principles of law. In particular, should the User not exercise such option, its right to intervene in the suit, under applicable rules or procedures, shall in no way be affected or diminished.

ARTICLE V - SAFETY AND ACCIDENT PREVENTION

a. The User shall:

1. Conform to all applicable laws and regulations governing safety and accident prevention, including the specific safety requirements contained in the WSMC and ESMC annexes to this Agreement.

2. Provide an adequate safety organization within its company that can effectively interface with the safety requirement of Range Safety organizations at ESMC and WSMC.

3. Take all reasonable steps and precautions to comply with and implement, as required by the Ranges, their respective safety programs as outlined in ESMCR and WSMCR 127-1, the applicable safety criteria prescribed in AFR 127 series, specific AF Occupational, Safety and Health (AFOSH) Standards/Regulations and Air Force Explosive Safety Regulations as specified by the Ranges from AFR 127-100. All subsequent editions, revisions, and supplements to these regulations shall be implemented within a mutually agreeable time schedule. User agrees to take all reasonable steps and precautions to prevent accidents, to preserve the life and health of all Users, Government, and operating contractor personnel and the general public that may in any way be affected by the User in the performance of this agreement. Violations of the Government's rules and regulations shall be grounds for the temporary suspension of work until the violations are corrected and ultimately may be grounds for termination of the Agreement, in accordance with Article XV, Termination by Government. The User agrees that Government safety representative will be allowed access to all facilities utilized in the performance of this Agreement, all paper work, system components, sub-system designs, operating/emergency procedures and any other material deemed necessary by the Government. The Government may by written order direct additional safety and accident standards as required for the performance of this Agreement. This access will be limited to the purpose of confirming the User's compliance with the safety requirements set forth in sub-paragraphs 1, 2, and 3 above. Any information or data accessed by the Government will be subject to protection as set forth in Article VIII, Information disclosure.

b. The Government may assign such personnel as it deems necessary to monitor the safety of activities of the User or its contractors and subcontractors at any launch site, production facility, assembly site, or site where a payload is integrated with a launch vehicle. The costs occasioned thereby shall be considered direct costs. This monitoring will be limited to the purpose of confirming the User's compliance with the safety requirements set forth in subparagraphs 1, 2, and 3 above. Access to facilities or monitoring activities at other than the Government's ESMC or WSMC sites will require a 48 hour courtesy notice to the User by the Government to include the number of personnel involved. The number of government

personnel to visit the facility and the purpose of the visit will be by mutual agreement of the parties. By conducting monitoring, the Air Force does not assume responsibility for the User's safety compliance, nor relieve the User of the primary responsibility to meet all applicable standards.

c. In the event of any accident involving injury, damage to, or loss of personnel or property, including real or personal property, the Government reserves the right to conduct complete investigations into the events surrounding the accident. The User agrees to support these investigations to the extent deemed necessary by the Government. When the Air Force is conducting the investigations, then the User will, in accordance with AFR 127-4, provide access to all documents and personnel who may have relevant information.

d. Compliance with subparagraphs a. through c. above shall not relieve the User from its obligations under this Agreement.

e. Notwithstanding any other provision of this agreement, the U.S. Government shall not be liable for damages incurred by the User or commercial system operator resulting from Government execution of flight termination systems or other Range Safety actions. The User shall indemnify and hold the Government harmless from any and all such claims.

ARTICLE VI - PERMITS AND RESPONSIBILITIES

a. Except as otherwise provided in this Agreement or any Annex or attachment hereto specifically with respect to environmental permits the User shall comply at its own cost and expense, with all Federal, State, or local laws and regulations which may be applicable to the operation of its business at a national range, including obtaining and paying for all necessary licenses and permits and paying all fees and charges.

b. The User shall have provided the PCO a copy of its current commercial space launch activities license, issued by the Department of Transportation, 10 days before a launch.

ARTICLE VII - LAUNCH DATA

a. The User shall prepare a quick look technical report which will provide the Center Commander with a brief description of: (1) the launch and spacecraft mission, (2) flight events summary, and (3) launch vehicle and spacecraft performance and a discussion of any safety anomalies that may have occurred. This report will be submitted 48 hours following launch.

b. Any such data obtained by the government shall be protected in accordance with Article VIII, information disclosure.

ARTICLE VIII - INFORMATION DISCLOSURE

Technical Data Furnished to the Government by the User

a. To the extent that the user provides to the Government any information it considers to be proprietary and any data in which it considers to have limited rights, the user shall identify such information and data by marking it as such by the time such information and data is provided to the Government.

b. Within the Government and its contractors disclosure of any information and data provided to the Government with the markings described in subparagraph a. above shall be limited only to persons having a need to know and in support of the launch and associated services to be provided under this Agreement. Disclosure to any non-Government person shall be provided only after such person has

agreed in writing to protect the subject information and data from unauthorized use, duplication, and disclosure.

- e. Any markings on proprietary information and data with limited rights shall be retained on any reproduction of such data in whole or in part.
- d. Notwithstanding the limitation on distribution of data among government and government contractor employees, any information and data provided to the Government with the markings described in subparagraph a. above shall be protected by the Government as provided in subparagraph c below and in accordance with the Freedom of Information Act, 5 U.S.C. 552, and Air Force Regulation 12-30.

ARTICLE IX - DISPUTES

- a. Except as otherwise provided in this Agreement, all disputes arising under or relating to this Agreement shall be resolved under this Article. Any dispute arising under this Agreement which is not disposed of by agreement between the user and the Government shall be decided by the Contracting Officer, who shall reduce his decision to writing within 60 days and mail or otherwise furnish a copy thereof to the User.
- b. The decision of the Contracting Officer shall be final and conclusive unless, within 30 days from the date of receipt of such copy, the User mails or otherwise furnishes to the Contracting Officer a written appeal addressed to the Secretary of the Air Force. The decision of the Armed Services Board of Contract Appeals as the duly authorized representative of the Secretary of the Air Force shall be final and conclusive concerning questions of fact unless determined by a United States court of competent jurisdiction to have been fraudulent, or capricious, or arbitrary, or so grossly erroneous as necessarily to imply bad faith, or not supported by substantial evidence. In connection with any appeal proceeding under this Article, the User shall be afforded an opportunity to be heard and to offer evidence in support of his appeal. Pending final decision of a dispute hereunder, work under the Agreement will continue elsewhere provided herein.

ARTICLE X - PROPERTY DISPOSITION

- a. At the conclusion of performance as required hereunder, the User agrees to remove all User property at no cost to the Government, within sixty (60) days. User property will be considered abandoned unless the ACO is notified otherwise in writing within sixty (60) days after project completion. Property not removed within a reasonable time thereafter may be considered by the ACO to be abandoned.
- b. User shall be charged all direct costs incurred by the Government associated with the disassembly, removal, storage, shipping, and/or disposal of any User property abandoned under subparagraph a. above.

ARTICLE XI - FINANCIAL ARRANGEMENTS

- a. The User will reimburse the Government for all direct costs incurred by the Government in connection with or incidental to the furnishing of goods and services under this Agreement which are deemed by the Government to be proper. Such reimbursable direct costs shall be determined and charged in accordance with the following principles and procedures:

1. Public Law 98-575, Section 15
2. NSDD-94
3. Executive Order 12465 February 24, 1984
4. Department of Defense Directives 3230.3 and 3200.11
5. Any conflicts within these principles and procedures will be resolved by giving precedence in the order listed.

b. The parties recognize that the User does not obtain title or any other legal or equitable right or interest in, any property, real or personal, by reimbursing the Government for part of the costs of that property, pursuant to this Agreement.

c. The User shall reimburse the Government in accordance with the following:

1. Estimate of costs

(a) Annex C of this Agreement sets forth the Government's estimate of the total direct costs which will be incurred in connection with the providing of goods and services.

(b) The estimate of direct costs shall be updated and submitted to the User by the ACO if events occur that would make the current estimate differ significantly.

2. Payment

(a) The User shall make two incremental deposits with the Government's accounting and finance offer at ESMC or WSMC as follows. The first will be an amount equal to the estimated costs as set forth in Annex C for the first six months of the Agreement, exclusive of test support and launch support. This deposit will be made at least ten working days prior to the Government's commencement of its obligation to perform. The second deposit will be an amount equal to 100% of the test support and launch support costs and will be due 120 prior to the scheduled launch date. Both of these deposits will be credited to the User's account and will be debited on a monthly basis as set forth below. Any balance remaining at the end of this Agreement will be returned to the User. When lengthy time periods may elapse between conclusion of a launch and the Government's next commencement of performance under this Agreement, the parties may agree to liquidate this deposit and then reestablish another deposit at least 10 days prior to the start of additional performance by the Government with the second deposit due 120 days prior to scheduled launch. Liquidation will follow the settlement procedures set forth below.

(b) Each month the Government will draw down from the User's account an amount equal to the previous month's actual direct costs incurred by the Government in the performance of this Agreement. The User will receive monthly statements. The User shall replenish the account quarterly to a level equal to the next 6 months' costs. The Government's performance under this agreement will be suspended if, in the estimate of the ACO, insufficient funds remain in the account to cover the next 45 days of Government cost. Work may not be suspended by the Government without first notifying the User, in writing, three working days prior to suspension.

(c) If during the term of this Agreement the User repeatedly fails to make quarterly replenishments, then the Government may terminate this Agreement pursuant to Article XIV, Termination by the Government.

NOTE: The Air Force is willing to consider alternate methods of effecting payment. Any alternate methods such as using interest-bearing commercial escrow accounts, letters of credit, etc., can be discussed at the time of individual Agreement executions. Any proposed alternate payment method must provide for timely monthly payments to the Government and a guarantee of prompt payment to the Government once the service has been performed.

3. Settlements

(a) Interim settlements will occur either annually or at the conclusion of a launch, at the election of the User. Additionally, a final settlement will occur at the completion of this Agreement. As promptly as possible after these events, the ACO will:

(1) Make a determination of the actual direct costs.

(2) Report the results to the User.

(b) The User's account will be debited for any Government direct costs not previously recorded against the User's account.

4. The User shall have a right to request review of the direct costs as set forth below. If the User's account contains a surplus after a completion of launch interim settlement, the User may elect to withdraw the surplus provided that a new account is established 10 days prior to the start of additional performance by the Government. Otherwise, the remaining balance will count against future work. Surplus funds remaining after an annual interim settlement will be retained for future use. Surplus funds remaining after a final settlement will be returned to the User. It is understood that the above provision does not constitute authorization to defer or postpone payments due under this Agreement. All amounts that become payable to the Government after any settlement shall bear an interest charge if they are not paid within 30 calendar days of receipt. The interest to be charged shall be an amount computed at the rate established for interest due to the Government by the Department of treasury effective on the due date. Interest shall be computed on the actual number of days after the due date on the basis of 360 days in a calendar year.

5. Appeals

The User shall have the right to request a review of the direct costs within 30 days after receipt of a monthly statement or any settlement determination. After conducting the requested review, the ACO shall make a final written decision regarding direct costs. Disagreement on the final decision will be considered under Article IX, Disputes. The amount of direct costs being disputed under the Dispute Article shall not be deductible from the User's account in the case of monthly billings nor shall it not be due and payable in the case of a settlement until a final resolution under the Article IX, Disputes, is reached. However, interest shall accrue in favor of the Government on any direct costs sustained under the dispute proceedings starting from the date the PCO receives a request for a final decision under the Disputes Article and ending when the sustained amount is deducted from the User's account or paid by the User to the Government. Interest shall be calculated as set forth above.

ARTICLE XII - SUPPORT INTERRUPTIONS

a. The use or commitment of Center resources shall be requested in accordance with applicable and updated range scheduling regulations.

b. The Centers will act in good faith and negotiate to minimize scheduling and support conflicts. It is the government's intention to accord commercial users a high degree of stability in conducting their commercial launch business. The Centers shall provide facilities and services in accordance with applicable and updated policies and procedures. In areas where conflicts may occur, the following ground rules shall apply:

1. The Government shall have priority in the use of Government property, and support services to meet national security interests or U.S. government mission requirements. The government decision to exert its first priority rights shall be made by the Center Commander. In the event the Government asserts its first priority right, the Government will make its best effort to coordinate with the User in advance (except in emergency situations when the Government must act immediately) so that the User may adjust its work schedules to minimize the impact of an interruption.

2. The User access to Government property, facilities, equipment, and support services is provided on a non-interference basis, with the express understanding that even when the User has been provided access, the Government may invoke its right to first priority access.

3. The Government reserves the right to require User personnel to vacate the launch complex or other work areas when their presence would constitute a safety, health, or security hazard due to launch

or other activities at adjacent facilities on Cape Canaveral Air Force State, Kennedy Space Center or Vandenberg AFB.

4. Hazardous operations at the launch site area will be approved by either WSMC or ESMC range scheduling as appropriate.

c. The Government shall not be liable for any costs, including but not limited to consequential damages incurred by third parties, the User, its contractors, or subcontractors as a result of any interruption.

ARTICLE XIII - TERMINATION BY USER

a. The User may terminate this Agreement at any time by notifying the PCO in writing. Should the User elect to terminate this Agreement, it will reimburse the Government for all direct costs incurred up to the date of receipt by the PCO of its termination notice and shall also reimburse the Government for all direct costs incurred in restoring the facility and equipment to the condition they were in before preparations were made to conduct the launch services, as well as other termination costs resulting directly from the termination, pursuant to Article XI, Financial Arrangements.

b. The rights and remedies of the Government provided by this clause are in addition to any rights and remedies provided by law or otherwise in this Agreement.

ARTICLE XIV - TERMINATION BY GOVERNMENT

a. The Government may terminate this Agreement in its entirety immediately upon the happening of any of the following events. Such termination shall be effective on the thirtieth (30th) day after receipt of written notice by the User:

1. The User voluntarily abandons or discontinues commercial space transportation operations, and shows no evidence that it will resume its efforts within a reasonable period of time, provided, however, that suspension of operations by the User during a strike or work stoppage by its employees, shall not be considered voluntary abandonment or discontinuance of operations.

2. The User has demonstrated an inability to conduct its operations in a safe manner, has jeopardized personnel and property through its actions, and, despite notice to correct its safety deficiencies, shows no evidence of correcting its shortcomings.

3. The User is in arrears in its payments.

4. Requirements are developed for critical, conflicting national security or other governmental launches or launch activities which cannot be reasonably satisfied by such means as schedule adjustment, and therefore preclude the Government from making available to the User, as excess capacity, all or substantial portions of the Government facilities and services otherwise provided for in this Agreement.

b. If the Government terminates this agreement it shall not be liable for any costs, including, but not limited to consequential damages or any other costs, experienced by third parties, the User, its contractors or subcontractors as a result of such termination.

ARTICLE XV - PERSONNEL ASSURANCE PROGRAM

a. This clause applies only to Users who will require employees access to launch pads or payload processing facilities on a "shared basis" with the Government, i.e., those launch pads or payload processing facilities that are also used to conduct Dept of Defense (DOD) launches.

b. HQ Space Division Regulation (SDR) 55-3, 30 June 1986, as it may be supplemented or revised, requires certification of all personnel whose duties require access to DOD flight hardware (those elements of equipment necessary for the attainment of operational capability of a DOD ballistic or DOD satellite program), who occupy a command or control position (a position where the incumbent has direct responsibility for conducting a DOD launch or expenditure of a DOD missile or DOD space booster), or whose duties require technical knowledge or competence vital to the successful accomplishment of the ultimate mission of a DOD ballistic or DOD satellite program. It is anticipated that User employees performing work under this Agreement which requires use of shared DOD property facilities or resources may fall into the first of the above categories. The User shall identify such employees and take steps to have each such employee certified in accordance with the procedures set out in SDR 55-3, unless such employee is otherwise certified under a reciprocal program recognized under SDR 55-3.

c. The User shall provide a copy of the list of employees so identified to the ACO. The ACO reserves the right to identify additional positions which shall be required to be subject to certification under SDR 55-3 if it is in the best interests of the Government to do so.

d. It is the User's sole responsibility to assure that employees capable of certification under SDR 55-3 are utilized in positions requiring such certification under this Agreement. In the event an individual identified as occupying a position requiring certification is denied certification, the User shall take appropriate steps to deny entry to the range for that individual.

ARTICLE XVI - APPLICABLE LAW

The parties hereby designate the United States law to govern this Agreement for all purposes, including, but not limited to, determining the validity of this Agreement, the meaning of its provisions, and the rights, obligations, and remedies of the parties.

ARTICLE XVII - ASSIGNMENT OF RIGHTS AND RESPONSIBILITIES

The User shall not assign any part of its rights or responsibilities under this Agreement. This shall not prohibit the Government, however, from recognizing a third party as the User's successor in interest to this agreement when the third party's interest in the contract arises out of the transfer of (1) all of the contractor's assets or (2) the entire portion of the assets involved in performing the agreement.

ARTICLE XVIII - CHANGES

Should the policy of the U.S. Government, as reflected by statute, regulation, rule, practice, or otherwise, subsequently authorize the Air Force to change the terms of this Agreement, the Air Force agrees to modify this Agreement, at the User's request, to reflect such changes. Those changes shall be retroactive to the maximum extent permitted by that policy.

ARTICLE XIX - EFFECTIVE DATE OF AGREEMENT

This Agreement shall enter into force and effect the date of the last signature of the parties.

ARTICLE XX - SCOPE OF AGREEMENT

Subject to terms and conditions of this Agreement, the following applies to User's launch operations at ESMC for User's launches taking place on ESMC Launch Complex X. The Government agrees to use its best efforts to allow a (User's ELV) launch rate of up to nine launches to include commercial and government launches in Government fiscal year 1989, and to use its best efforts to allow a (User's ELV)

launch rate of up to twelve launches to include commercial and government launches in each Government fiscal year from 1990 through 1994, provided that a satisfactory agreement can be reached on launch periods. The parties shall mutually agree as soon as reasonably practicable on specific launch periods to be allocated to the User during each of the fiscal years covered by this agreement. Additional User launches will be considered by the Air Force on a case-by-case basis. An annual launch capability review will be held two years in advance of the earliest User-proposed launch period in such fiscal year. The purpose of these annual reviews shall be to coordinate launch plans and reach agreement on the launch period for launches during such fiscal year. The resulting agreement from each annual review shall be captured in a modification signed by both the Government and User to this agreement.

In witness whereof, the parties have executed this Agreement

FOR THE GOVERNMENT

FOR THE USER

Special Assistant
Deputy Commander for Launch Systems

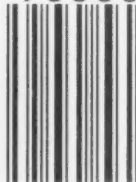
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